

80-15

C-CORE

Technical Report

Iceberg Tracking Program,
Pointe Amour, Labrador
Final Report

Chantal Roche

October 1980



ICEBERG TRACKING PROGRAM
POINTE AMOUR, LABRADOR

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Final Report

Submitted to the SNC-LAVALIN Newfoundland Limited

Technical Report
C-CORE Publication No. 80-15
October 1980

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The Centre for Cold Ocean Resources Engineering (C-CORE) was established at Memorial University of Newfoundland in St. John's in 1975. Its initial funding was provided by the Devonian Group of Charitable Foundations of Calgary. Ongoing funding now comes from government and industry.

The Centre's mandate is to undertake research that will assist the safe and orderly development of Canada's resources in cold and ice frequented oceans. C-CORE's main concentration of research is on ice, its properties, detection behaviour, on the interaction between oil and ice, and on seabed engineering.

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ISBN: 0-88901-029-8

SUMMARY

A forty-four kilometer sector of the Strait of Belle Isle, centered on Pointe Amour, was monitored between June 1979 and June 1980 primarily to obtain a record of iceberg movements. Coverage of this area was maintained for 89 percent of the observation period using an X-band radar recorded by a 16 mm time-lapse camera.

Thirteen icebergs were identified by visual sightings and or from the film records. An additional twelve radar targets were identified from the films as likely to be icebergs or bergy bits bringing the total to 25. The sightings were either on the north side of the Strait or in mid-channel. No bergs were detected along the Newfoundland shore.

An estimate of the density of shipping moving through the Strait of Belle Isle was also obtained from the radar records. Most of the traffic passed between June and December with a peak in August. A total of 1248 vessels were recorded moving directly through the area of radar coverage during these months.

ACKNOWLEDGEMENTS

The author would like to acknowledge the contributions made by a number of people and organizations to the program covered in this report. The cooperation of the Canadian Coast Guard who made available the Pointe Amour lighthouse facilities for the study is much appreciated. A particular thanks is extended to the lighthouse keepers, Mr. S. Hancock and Mr. M. Sheppard for their efforts throughout the program. The Lower Churchill Development Corporation through SNC-LAVALIN Newfoundland Ltd. provided partial funding. Mr. A. Allan on the management side of the program and Mr. J. Johnstone who was responsible for the design, fabrication, installation and upkeep of the equipment, are among those at C-CORE without whom the study would not have been possible.

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1. INTRODUCTION

This report presents the results of the iceberg tracking program carried out by C-CORE from June 1979 to June 1980 with the support of the Lower Churchill Development Corporation (LCDC) through SNC-LAVALIN Newfoundland Limited. LCDC are investigating the feasibility of laying a submarine cable across the Strait of Belle Isle to transmit power from the Churchill River across to insular Newfoundland. The record of shipping activity and of iceberg drift patterns and numbers in the environs of the cable route documented in this report will be used by LCDC in assessing the risk of damage to bottom installations.

The program was initiated in June 1979 to appraise a shore-based radar system for tracking icebergs. Iceberg movements were to be recorded using a time-lapse cine camera set up to monitor the display of an X-band marine radar. This system was installed at Pointe Amour, Labrador with the intention of covering a sector across the Strait of Belle Isle for the June - August iceberg season. Encouraging results lead to a continuation of the iceberg tracking program with the following objectives (in order of priority):

- (1) to extend the iceberg records to cover a full year, from June 1979 to June 1980;
- (2) to obtain an estimate of the density of shipping moving through the Strait of Belle Isle;
- (3) if possible, to derive information on the pack ice conditions from the radar record.

This report contains a brief description of the equipment used and a summary of the records obtained over the twelve month period. The trajectories of radar echoes that were identified as icebergs are plotted, accompanied by tables of their hourly positions relative to the Pointe Amour lighthouse. Additional radar echoes that could not be positively identified are presented in the same manner. All radar targets identified as ships moving directly through the Strait are tabulated by date and direction of travel. Some remarks on the absence or presence of pack ice as indicated by the film records are included.

2. METHODS AND MATERIALS

The system used to monitor the iceberg movements in the Strait of Belle Isle consisted of an X-band marine radar, a 16 mm cine camera and a camera drive system. The radar scanner was mounted on the Pointe Amour lighthouse at a height of approximately 43 metres above sea level. The radar display unit, housed within the lighthouse, was set up with the 16 mm camera recording the screen in a time lapse mode. The radar range was set at 12 nautical miles (22 kilometres) giving a coverage of the western end of the Strait as indicated in Figure 1. This resulted in 16 mm film records of iceberg and vessel traffic movements in this area for the period June 2, 1979 to June 1, 1980.

Period 1

From June to November, 1979 a Furuno FR240 Radar was used. Specifications are included in the Appendix. Low cost, availability and ease of installation were chief considerations in the choice of this particular radar. A standard 16 mm Bolex camera, (model H16 SBM), with a Kern-Switar 10 mm lens was used for the filming. An in-house drive system was made to provide exposures of 15 seconds at 4 minute intervals. The exterior and interior mountings of this system are seen in Figures 2 and 3.

Local personnel were contracted to maintain this system, which consisted of winding the spring-driven camera once in 24 hours and changing the 100 foot rolls of film at 10-11 day intervals. In addition they kept a daily log of film usage, descriptive notes on weather conditions and recorded any visual sightings of icebergs. When visibility permitted polaroid photographs of the icebergs were taken.

Period 2

As the lighthouse would be unoccupied during the winter the system used for data collection was replaced in December, 1979 to eliminate the need for daily maintenance and to improve the quality of the record.

A DECCA RM916 A radar replaced the FURUNO model used previously. Specifications for the DECCA are given in the Appendix. The major advantage of this unit was the ability to automatically suppress sea and rain clutter on the display using the VP-1 video processing feature. Removal of unwanted clutter was previously possible only through manual adjustment of the FTC (fast time constant), STC (sensitivity time constant) and Gain controls on the set. This continuous readjustment necessary was not compatible with unattended operation.

A similar camera and lens combination recorded the display screen after December, however, a number of changes were made in the camera drive component. These changes were affected to eliminate rewinding of the camera every 24 hours.

Initially a Lafayette Camera Drive System fitted for the camera by Photographic Analysis Ltd. was installed. A framing interval of 5 minutes with a 20 second exposure was chosen from an available range of intervals from 1 to 300 seconds. The exposures made by this unit were found to be erratic soon after its installation. An interim system was made up inhouse for use while the Lafayette Drive was returned to the supplier for repairs. The inhouse drive and timing motor were left in place for the remainder of the data collection. This system is shown in Figure 4.

A 24-hour LED clock and mirror system devised by Photographic Analysis Ltd. was used to record the time on each frame of data. The daily log of film footage and frame counts kept up to November for the

purpose of extracting this information could therefore be discontinued.

Since the mounting brackets for this clock unit were incorporated with the Lafayette camera drive system it was removed when the camera drive was sent back for repair. A temporary replacement consisting of two LED clocks with 12-hour time and date displays was installed.

All components of this system, with the exception of the radar scanner unit, were housed in a frame and light tight insulated, wooden box. (Figure 5). Not only did this housing serve to reduce the risk of interference from the curious but also provided some degree of insulation during the winter months.

Regular maintenance of this system involved the changing of the film at 10-11 day intervals. The weather and ice conditions visible from Pointe Amour were noted at the time of each film change. The local personnel continued to carry this out, alerting C-CORE of equipment problems when necessary.

Data Reduction

A 16 mm analytical projector (L-W 224-A mk II Photo-Optical Analyzer) that enabled projection of the film record at speed of 1 to 24 frames per second was used in the data reduction. An inhouse projection table was constructed to allow projection of the film onto a hydrographic chart of the Strait of Belle Isle or onto a standard radar plotting sheet.

The film was first viewed to correlate the frame numbers with the log book entries. Taking into account any interruptions or loss of record, the frame numbers were then divided into 24 hour periods. Before the installation of the clock as part of the recording system, the scheduled crossings of the St. Barbe/Blanc Sablon Ferry appearing regularly on the record served to verify this timing.

Radar targets of interest were noted by the frame numbers, date and time of the initial and final observations of the echoes. Identification of the targets was based on the size, direction and velocity of the echoes.

3. RESULTS

Radar

The film collected during the study period is noted in Table

1. Radar coverage of the Strait was maintained for 89% of the period from June 2, 1979 to June 1, 1980. Down time was due to either equipment malfunctions or time between film changes or installation of new equipment. The duration and cause of the periods of down time experienced are contained in Table 2. The clarity of portions of the record was at times reduced due to poor tuning of the display, jumps in the orientation of the display due to fluctuations in the power supply, or erratic exposures resulting from difficulties with the camera drive.

Target Identification

Ships

Vessel traffic moving through the Strait of Belle Isle could be readily identified on the film record. Radar targets that passed directly through the area of coverage accounted for the majority of vessel counts tabulated in Table 3. Exceptions occurred during periods of poor record where targets were obscured by sea or rain clutter, or were first detected only at close ranges due to poor tuning of the display. The identification of these targets as vessels was based on their average velocity (generally from five to eight metres per second, 10 to 15 knots), their position or movement down one of the shipping lanes or the large elongated shape of the echo.

Local Traffic

Smaller echoes with average velocities between 1.5 and five metres per second (3 to 10 knots), frequent changes in course and speed were identified as local traffic primarily engaged in fishing activities. Further characteristics of targets classed in this group included direction

of movement across the strait, or close to the coastline and a return to the initial position of observation. No tabulation of local traffic was made during the study.

Sea Ice

The detection of sea ice during the program was limited primarily to a two to four nautical mile (approx. 4 to 7 km) range on the radar display. At times scattered returns were visible out to a range of eight nautical miles (approx. 15 km). Occasional visual observations confirmed that the ice in fact extended well beyond this range.

The first sea ice on the film record appeared in December as loose strings of ice rarely extending beyond a two nautical mile range (approx. 4 km) from Pointe Amour. These returns were very sporadic in early December with no ice at all in evidence the 9th and 10th of the month. By December 16th heavier strings of ice would occasionally be detected out to a range of four nautical miles (approx. 7 km). It was not until mid-January that the ice returns became more concentrated, with small polynyas and shore leads now visible. The concentrated returns fell within a two nautical mile range (approx. 4 km) of Pointe Amour, although scattered ice targets were picked up at a four to six nautical mile range (approx. 7 to 11 km). Undeformed young ice extending the width of the strait was observed from the air during this period. Between January 21st and 29th the ice appears to have opened up again, with only strings appearing on the record. The ice returns continued to be very light until February 7th, then again became concentrated until February 14th. This pattern of concentrated returns clearing to strings of ice continued on the record until the end of February. The detection range increased in heavy ice to an average of three to four nautical miles (approx. 6 to 7 km). The direction of ice drift

varied, flowing back and forth with the tidal streams and eddying clockwise in the mouth of Forteau Bay.

Fast ice was first seen in the record on the north shore of Forteau Bay, building rapidly after February 26th. A clear ice boundary across the mouth of the bay was evident by March 1st, indicating that the bay had completely frozen over. The bay opened up again in the first week of April.

Heavy concentrations of ice predominated throughout the March film record. A shore lead between the pack ice and the fast ice of Forteau Bay and the Labrador Coast could often be seen. Although generally under one-half a mile (approx. 1 km) wide, this lead occasionally extended almost two miles offshore (approx. 3 km) (13 and 17 March). Ice observations made at the lighthouse at the end of February and in March noted nine-tenths coverage of close pack or 'heavy winter' ice in the strait.

A more dispersed return from the ice appeared during April, although the small polynyas could still be seen in the pack. From May 7 to 20th the ice cover was very open with the returns on the radar concentrated in loose strings and scattered points. Many of these scattered echoes extended to a six (approx. 10 km), sometimes seven or eight mile range. (approx. 11 or 13 km). After this date very little ice information could be obtained from the records. Poor tuning on the display cut out all but the strongest targets in the area.

Entries in the observers log for this period are indicative of the clearing of ice in the Strait seen on the April and May film record. On April 9th the log records seven-tenths coverage of young ice across the Strait. "No ice" is entered for April 23rd. By April 29th the log refers only to bergy bits with a final reference to sea ice entered

on May 14th as "loose strings of ice".

Icebergs

The identification and tracking of radar echoes classed as icebergs was the principal concern in the reduction of the film records. All echoes that fell within this group were plotted at hourly intervals to obtain the berg trajectories shown in Figures 6 to 12. The accompanying tables (Tables 4 - 10) provide a breakdown of the drift of these bergs in terms of average velocity and course followed. The range and bearing given in the tables are relative to the Pointe Amour light-house.

All moving echoes identified as bergs had in common average velocities of less than one metre per second (2 knots), at least one reversal in the direction of drift and were observed to remain stationary for some period of time. During periods when sea ice was present in the Strait, this last characteristic (an indication of grounding), was particularly important in distinguishing iceberg echoes from rough or isolated floes of ice. The cross in Figures 6 to 12 indicate the position of grounding of each berg.

A second group of echoes that could not be positively identified as icebergs are plotted in figures 13 to 24. These targets were recorded after May 19, 1980 when the tuning of the radar display was extremely poor. No concurrent echoes appeared on the screen and the strength of the echoes tended to fluctuate. As seen in Table 11 to 22, the average velocity of all but one of these targets was under one metre per second (2 knots). This reduces the likelihood that they were small boats. Targets 1, 3, 6, 8, 9, 10 and 11 exhibit the reversal of drift characteristic of sea ice and icebergs in the Strait. None of the targets remained stationary during the period of detection.

It is felt that identification of these targets as small bergs or bergy bits is justified. Generally an iceberg or bergy bit would contribute stronger returns, more likely to be detected on the poorly tuned display than the return from sea ice. However, it is feasible that the aspect, surface configuration and size of isolated floes of sea ice could have produced returns strong enough to be detected.

Very few icebergs were sighted from Pointe Amour lighthouse during the year. Polaroid photographs of the sightings were made in June and August 1979 but were taken from too great a distance from the bergs to be of real value. The use of the camera was discontinued for the remainder of the project.

An estimation of the size of the icebergs sighted was made using the following International Ice Patrol system:

Classification	Size		Scale for Tabular Bergs	
	Height	Length	Height	Length
small	<15 m	<61 m	6.1 m	<9.1 m
medium	15-46 m	61-122 m	6.1-15m	91-213 m
large	46-78 m	122-213 m	>15 m	>213
very large	>78 m	>213 m	-	-

Because actual measurement of the iceberg size and position was not made by the observers the depth of water in which these icebergs grounded could not be established.

Two medium icebergs corresponding to Berg No. 1 and No. 2 from the film record were seen southwest of Pointe Amour on June 2, 1979. A second pair of medium bergs were observed on the same date, grounded just off Forteau. This pair were obscured by sea clutter on the radar record. The last sightings in 1979 were of two small icebergs off the lighthouse on the 23rd and 24th of August. These coincide with Berg

No. 3 detected on the radar. This berg was seen to break into two parts on the August 23rd records. The echo from one of the pieces faded very soon after the break.

The first sighting in 1980 was noted February 24 as a small berg moving west passed Pointe Amour. On 3 March a small berg was aground approximately one kilometre (1/2 nautical mile) west of the station. Neither of these targets could be picked out from among the sea ice returns on the film record. Scattered bergy bits were the only other form of glacier ice observed in the strait until the end of May. One medium iceberg about one mile (approx. 1.5 km) off the station was seen in fog on May 28th. This would coincide with Berg No. 7 from the film record. Under clear skies four days later the observers noted scattered bergs in the strait, one of which (Berg No. 9 from the film) was aground about three miles (approx. 5 km) off Pointe Amour.

4. DISCUSSION

Shipping

A fairly close estimate of the density of shipping moving through the Strait was gained from the program. Monthly variations in this traffic have been presented in Figure 25. It should be kept in mind that some adjustment in the relative volumes of traffic would be necessary to cover periods of lost record before accurate comparisons of volumes could be made.

July, in particular, could be expected to have a greater volume of traffic. An average of six vessels a day could have been missed at the beginning of the month, bringing the density of shipping closer to the peak counted in August.

A fairly even distribution between east and westbound movement through the Strait is in evidence. The number of eastbound vessels recorded for November might underestimate slightly the actual traffic. For the first ten days of the month the coverage of the strait was reduced to six nautical miles and thus did not include all of the eastbound shipping lane. However, given that deviations from the shipping lanes were prevalent throughout most of the records it is felt that most vessels were accounted for.

Sea Ice

Due to low detection range of sea ice on the radar, minimal information was obtained on ice conditions across the Strait of Belle Isle. Continually moving under the influence of wind and currents, the ice cover may vary widely throughout the length and breadth of the Strait. A comparison between the radar film records and the visual observations made when the radar site was visited to carry out equipment maintenance emphasized this point. Close pack ice visible on the radar records was seen to extend

across the strait, out of the detection range of the radar. However, at other times a similar radar record was observed when close pack on the north side of the Strait occurred in conjunction with loose strings of ice or open water in the centre of the channel or on the Newfoundland coast.

The first ice on the records was locally formed young ice. From mid-December to mid-February this ice occurred in a wide variety of concentrations, appearing to clear completely for periods. The low detection range of this ice on the radar (rarely greater than two nautical miles) (approx. 4 km) can be attributed to the low height above water and the absence of large surface roughness features of this ice.

The increase in the detection range to three or four nautical miles (approx. 6 to 7 km) in mid-February through to March and April would correspond with the buildup of thicker deformed ice and the influx of quantities of first year ice from the Labrador Coast. Clearing of this heavy ice cover began around Pointe Amour in mid-April with more open concentrations turning to loose pack by the end of the month. The inflow of first year ice from the Labrador Coast remained in evidence until mid-May. An increase in the number of bergy bits and deformed first year floes would account for the stronger echoes present beyond a four mile range during this period.

Icebergs

Detection of the bergs on the radar record ranged from a few hours to several days. The longer tracking times were due to periods during which grounding occurred rather than a full record of the drift in or out of the Strait. All of the iceberg sightings tended to be on the Labrador side of the Strait. The area off L'Anse-au-Loup showed the heaviest concentration.

The paucity of sightings off the Newfoundland shore is thought to reflect actual conditions and is not considered to be a characteristic of the detection system. The echo strength from an iceberg should be no less than that from the small boat targets that were regularly picked up at this range.

The three bergs tracked in 1979 are the most complete in terms of detection while within the area of coverage. Berg 1 and Berg 2 from 2-6 June were grounded in the area at the beginning of the tracking program so were not seen entering the Strait. They did however, remain visible until drifting into a blind section of the coverage area in Forteau Bay. Berg No. 3 (August 23-24) was detected entering the area at a range of 21.1 km (11.4 n. miles) and was followed until it too passed out of the coverage area near L'Anse-au-Loup. It is not known whether these three bergs remained along the coast until melting or drifted out of the area. All the other bergs first appeared on the radar record well within the area of coverage at ranges from eight (approx. 15 km) to less than three nautical miles. (approx. 6 km). Apart from the two grounded bergs still in the area June 1, 1980 (Berg 8 and Berg 9), the echoes from these targets disappeared in a similar manner. As a result exactly how long the bergs remained in the Strait and by what route they drifted in or out could not be established.

The characteristics of the targets will in part account for this sporadic detection. The range in shapes and sizes of icebergs result in a wide variation in echo strength picked up by the radar. As a berg rolls or turns, a change in the aspect relative to the radar beam could contribute a reduction in the echo strength sufficient to cause a loss of detection. The poor tuning of the display referred to earlier would compound this effect so that even medium bergs could be lost at far ranges.

During the twelve month period of observation thirteen icebergs were noted in the area. The addition of the twelve radar targets observed in the May 1980 film records would bring the total up to twenty-five. Table 23 summarizes the record of visual and radar sightings. All but eight of these sightings were made in May, 1980 yet as illustrated in Table 24, at no time was there a large concentration of bergs or targets in the Strait.

The iceberg season in the Strait of Belle Isle is generally considered to fall between the end of April and the end of July. Icebergs noted during the iceberg tracking program therefore cannot be considered to cover two complete seasons. Four of the five icebergs noted during 1979 were already grounded in the area indicating that the peak of the iceberg season in the Strait had already passed. Given the sporadic returns characteristic of icebergs it is possible that not all the icebergs in the area were detected during the 1980 season. However from the few visual sightings it appears that to date this year (1980) has been a light year in terms of ice and iceberg numbers through the Strait. It would appear that a reasonably complete count of icebergs was made during the program.

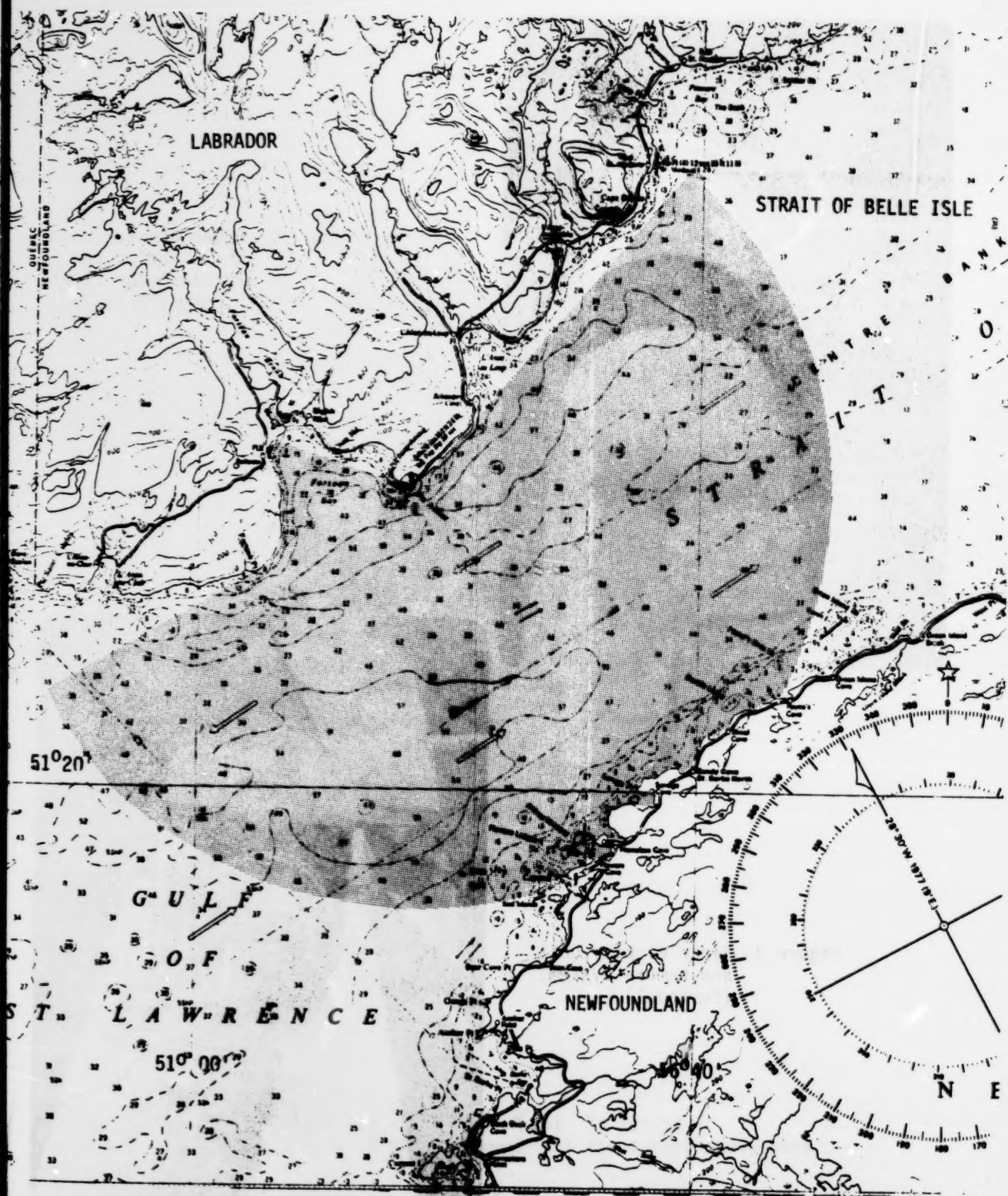


Figure 1 Location of radar installation and range of coverage (Portion of Canadian hydrographic chart no. 4020. Depths in fathoms.)

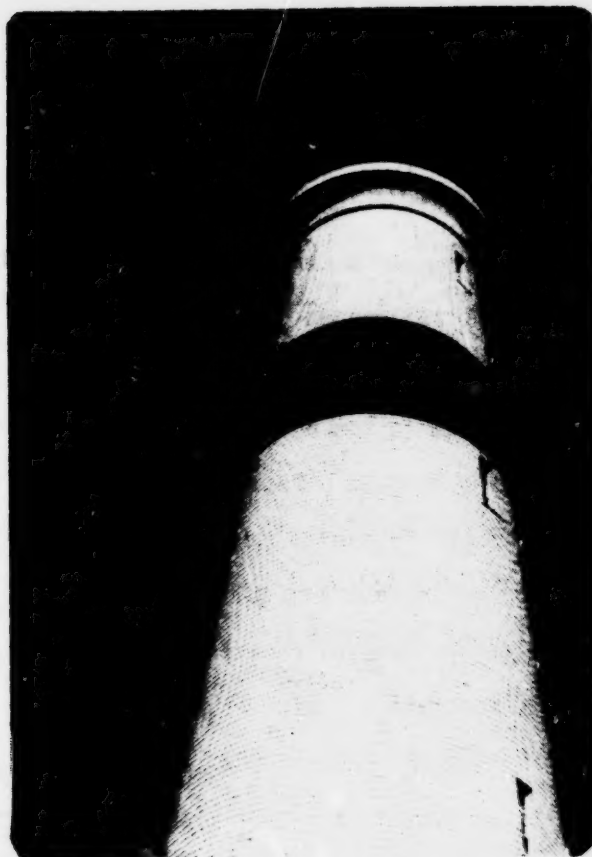


Figure 2 Radar scanner unit
installed on the
Pointe Amour Light-
house. (Period 1)

Figure 3 Radar display unit
and camera system.
(Period 1)



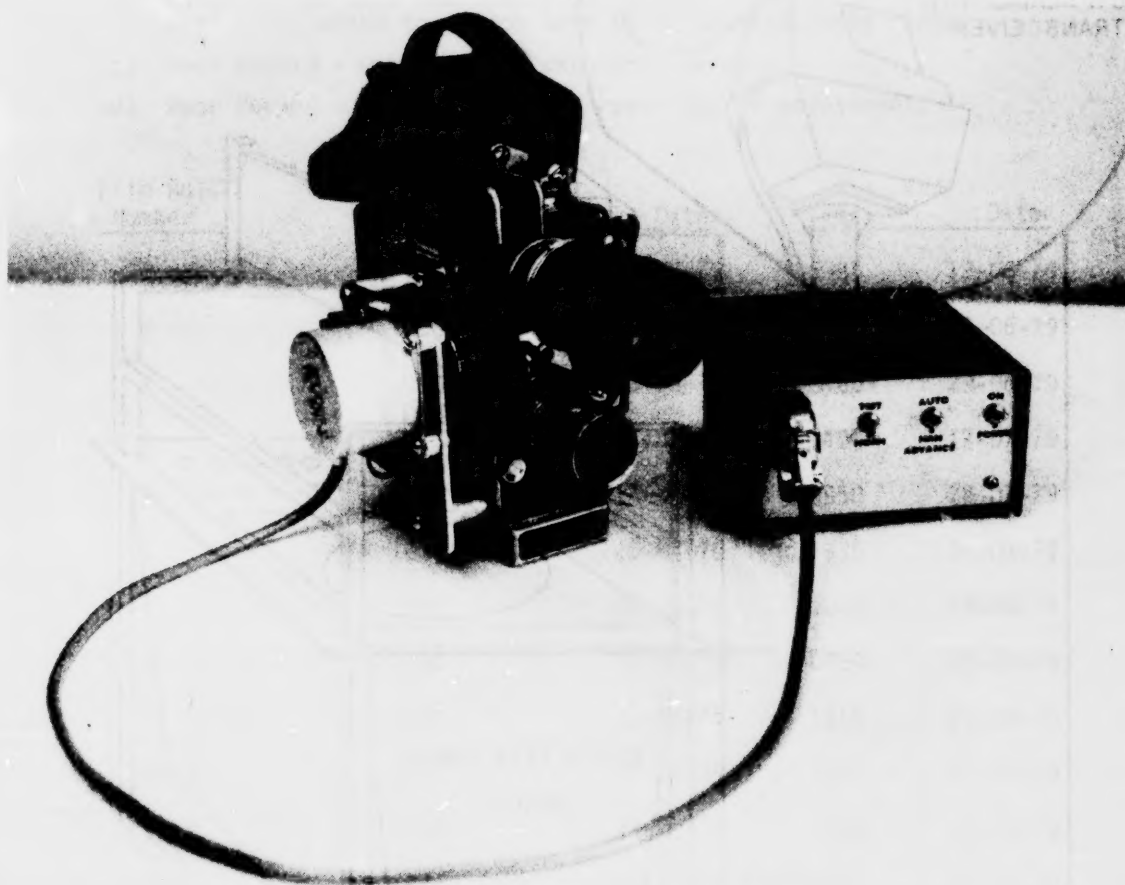


Figure 4 - Camera and drive system used in Period 2
(Single 10 mm lens used, not the turret shown here).

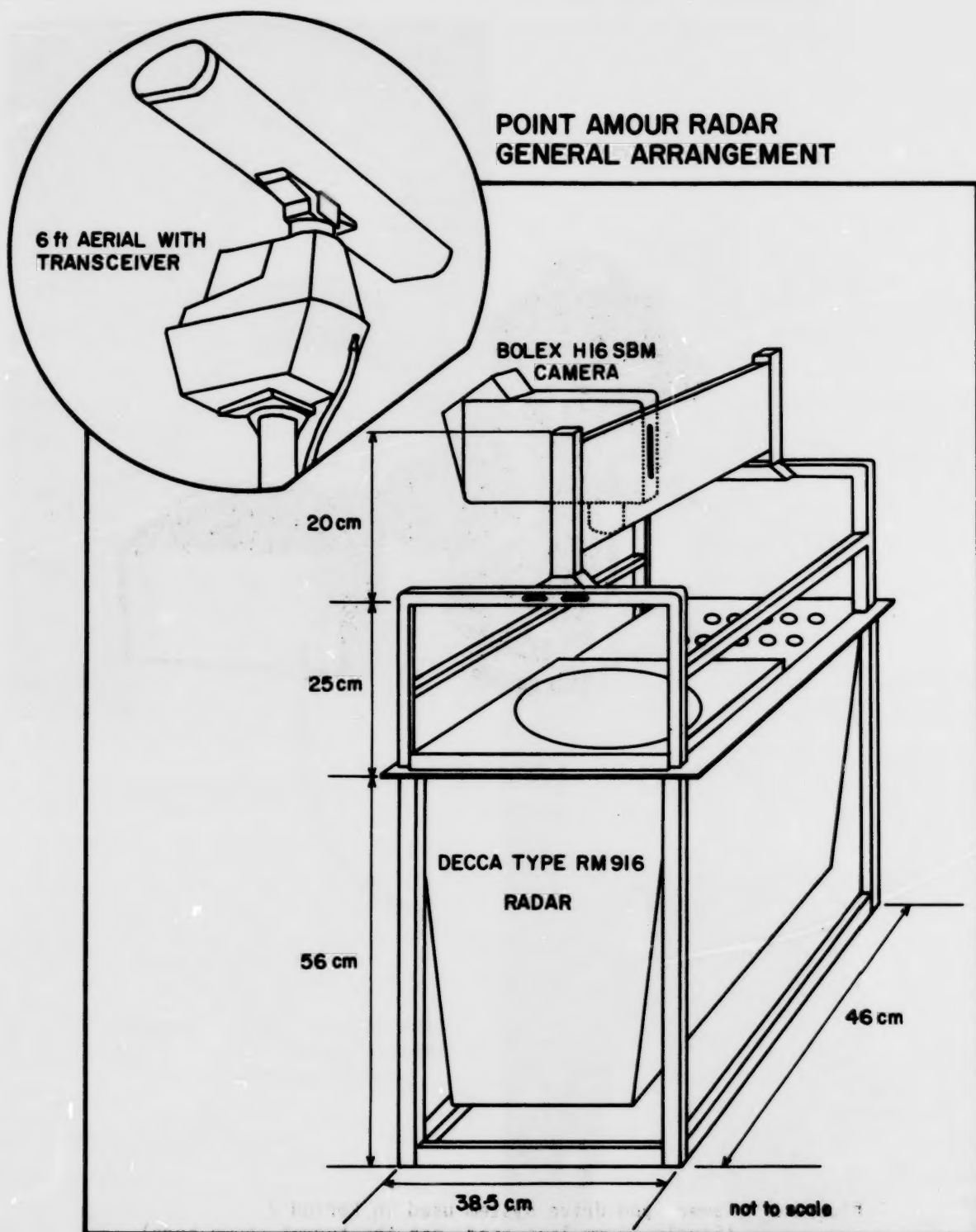


Figure 5 General arrangement of radar and camera system used during
Period 2

TABLE I
FILM RECORD

- (a) Poor Record - frequent jumps & breaks due to power failures or camera sticking
- (b) Range change to 6 nautical miles during a search for missing small boat - neglected to switch back to 12 nautical mile range.
- (c) Poor Record - camera drive exposures erratic.
- (d) Poor Record - coarse tuning on radar out of adjustment.

Film Roll Number	Start		End	
	Time	Date	Time	Date
1	1010	02-06-79	0934	13-06-79
2	1000	12-06-79	0930	23-06-79
3	0950	23-06-79	0100	29-06-79
4	1128	07-07-79	1400	17-07-79
5	1415	17-07-79	0950	28-07-79
6	1000	28-07-79	1335	08-08-79
7	1250	08-08-79	1045	19-08-79
8	1100	19-08-79	0954	30-08-79
9	0955	30-08-79	1315	10-09-79
10(a)	1325	10-09-79	2252	22-09-79
11(a)	1400	23-09-79	1320	05-10-79
12	1845	05-10-79	1705	16-10-79
13	1730	16-10-79	2030	27-10-79
14(b)	2040	27-10-79	0512	08-11-79
15	0927	08-11-79	1208	19-11-79
16	1955	21-11-79	1348	01-12-79
1 - D	1737	01-12-79	2243	02-12-79
2 - D	2308	02-12-79	1520	12-12-79

Table 1 Cont'd

<u>Film Roll Number</u>	<u>Start</u>		<u>End</u>	
	<u>Time</u>	<u>Date</u>	<u>Time</u>	<u>Date</u>
3 - D	1550	12-12-79	1210	22-12-79
4 - D	1932	22-12-79	1435	05-01-80
5 - D (c)	1450	05-01-80	1200	14-01-80
6 - D	1505	14-01-80	1048	21-01-80
7 - D (c)	1109	21-01-80	1024	29-01-80
8 - D (c)	1400	29-01-80	1220	07-02-80
9 - D	1625	07-02-80	1501	20-02-80
10 - D	1545	20-02-80	0951	03-03-80
11 - D	1107	03-03-80	0224	17-03-80
12 - D	1146	17-03-80	1010	26-03-80
13 - D	1142	26-03-80	0525	09-04-80
14 - D	1135	09-04-80	1009	22-04-80
15 - D	1459	29-04-80	1235	13-05-80
16 - D (d)	1523	14-05-80	1300	28-05-80
17 - D (d)	1431	29-05-80	1041	01-06-80

Table 2 Interruptions in Coverage During the Iceberg Tracking Program

MONTH	DURATION AND CAUSE	TOTAL
1979 June	47h	6.5 days
July	155h 28m	
	50m Power cut	
August	Nil	Nil
September	1h 45m System turned off to connect batteries 7h 25m Camera stuck 11h 10m Camera stuck 10h 18m Camera stuck 15h 08m Time lost between film changes 5h 56m Camera stuck 3h 08m Camera stuck	2.3 days
October	10h 36m Camera not wound 5h 25m Between film changes 25m Between film changes 25m Camera shut off for small boat search and rescue	0.7 days
November	4h 15m Between film changes 31h 47m Film supply out	1.5 days
December	3h 49m Installation of Decca system 7h 10m Between film changes	0.5 days
1980 January	213h 25m Radar scanner motor U/S Camera drive erratic 3h 36m Between film changes	9.0 days
February	4h 05m New camera drive installed	0.2 days
March	1h 16m Between film changes 83h 46m Radar scanner U/S 46h 13m Radar U/S 97h 43m Radar U/S	9.5 days
April	1h 05m New radar scanner motor installed 6h 10m Between film changes 172h 50m Camera drive U/S	7.5 days
May	27h Between film changes 25h 31m Between film changes	2.2 days
		39.9 days

Table 3 Strait of Belle Isle - Summary of Through Traffic
JUNE 02, 1979 - JUNE 01, 1980

DATE	JUNE			JULY			AUGUST		
	I	II	III	I	II	III	I	II	III
01							5	2	7
02	1	NO RECORD			NO RECORD		4	6	10
03	1	0	1		NO RECORD		7	5	12
04	0	0	0		NO RECORD		10	8	18
05	1	2	3		NO RECORD		5	6	11
06	2	2	4		NO RECORD		7	5	12
07	1	1	2		NO RECORD		2	3	5
08	1	0	1	5	4	9	9	4	13
09	2	1	3	5	2	7	2	6	8
10	3	2	5	3	3	5	6	7	13
11	4	0	4	2	2	5	3	3	6
12	3	6	9	3	4	9	2	7	9
13	1	2	3	4	7	11	5	5	10
14	0	2	2	5	4	9	3	2	5
15	0	2	3	4	3	7	3	5	8
16	2	4	6	4	4	8	7	4	11
17	2	1	3	2	2	4	4	8	12
18	0	1	1	7	8	15	4	9	13
19	3	3	6	2	3	5	9	2	11
20	1	1	2	8	5	13	4	3	7
21	1	1	2	9	2	11	7	4	11
22	2	3	5	7	5	12	4	6	10
23	3	3	6	5	1	6	7	4	11
24	3	2	5	2	8	14	6	5	11
25	3	2	5	6	8	9	8	3	11
26	3	1	4	4	5	9	6	3	9
27	2	4	6	2	7	9	3	4	7
28	3	0	3	4	6	10	5	3	8
29		NO RECORD		3	3	6	5	6	11
30		NO RECORD		3	5	8	2	1	3
31				1	3	4	2	5	7
TOTALS	48	48	96	105	108	213	156	144	300

I - Number of ships moving east II - Number of ships moving west III - Sum of I and II

Table 3 Cont'd

DATE	SEPTEMBER			OCTOBER			NOVEMBER			
	I	II	III	I	II	III	I	II	III	
01	5	6	11	2	5	7	2	2	4	
02	3	5	8	3	7	10	1	4	5	
03	3	6	9	2	1	3	1	1	2	
04	4	4	8	2	5	7	3	2	5	
05	6	2	8	2	4	6	2	3	5	
06	4	6	10	1	4	5	0	3	3	
07	8	8	16	7	6	13	2	1	3	
08	2	4	6	1	5	6	2	1	2	
09	6	3	9	2	3	5	1	2	3	
10	10	14	14	2	7	9	5	5	10	
11	4	7	11	2	6	8	3	4	7	
12	4	4	8	3	4	7	2	2	4	
13	4	1	5	2	1	3	2	0	2	
14	3	2	5	1	6	7	2	1	3	
15	3	4	7	4	14	8	1	0	1	
16	1	7	8	5	2	7	3	4	7	
17	4	9	13	4	0	4	2	1	3	
18	2	2	4	4	4	9	3	1	4	
19	3	6	9	5	6	10	2	0	1	
20	1	1	2	7	6	13	1	NO RECORD		
21	6	4	10	6	3	9	0	1	1	
22	7	2	9	2	3	9	0	4	4	
23	1	0	1	2	6	8	3	4	7	
24	4	8	12	4	1	5	3	0	3	
25	0	2	2	4	2	6	3	0	3	
26	3	5	8	4	1	5	2	1	3	
27	0	4	4	3	1	4	2	1	3	
28	3	7	10	0	4	7	2	1	5	
29	3	6	9	4	3	3	2	3	2	
30	2	4	6	0	3	4	0	2	2	
31	-	-	-	3	1	4	-	-	-	
TOTALS	109	133	242	93	112	205	54	54	108	

Table 3 Cont'd

DATE	DECEMBER			JANUARY			FEBRUARY		
	I	II	III	I	II	III	I	II	III
01	2	1	3						
02	2	1	3						
03	2	2	4						
04	2	2	4						
05	2	1	3						
06	3	3	6						
07	1	3	4						
08	1	2	3						
09	1	1	2						
10	3	1	4						
11	1	2	3						
12	3	6	9						
13	1	0	1						
14	2	4	6						
15	5	1	5						
16	5	0	5						
17	5	0	5						
18	3	0	3						
19	0	2	2						
20	0	2	2						
21	3	0	3						
22	0	0	0						
23	0	0	0						
24	0	0	0						
25	0	0	0						
26	0	1	1						
27	0	0	0						
28	0	0	0						
29	0	0	0						
30	0	0	0						
31	1	1	2						
TOTALS	48	36	84	0	0	0	0	0	0

Table 3 Cont'd

DATE	MARCH			APRIL			MAY		
	I	II	III	I	II	III	I	II	III
01									
02									
03									
04									
05									
06									
07									
08									
09									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									
30									
31									
TOTALS	0	0	0	0	0	0	7	6	13

Berg No. 1

Table 4

Point Plotted	Date	Time	Elapsed Time (hours)	Range (km)	Bearing ($^{\circ}$ T)	Average Direction ($^{\circ}$ T)	Average Velocity (m/s)
00	2-6-79	1010h	0.0	12.4	237 $^{\circ}$	078 $^{\circ}$	T
62	4-6-79	2342	61.53	11.5	236 $^{\circ}$	010 $^{\circ}$	Negligible
64	5-6-79	0206	63.93	11.3	237 $^{\circ}$	078 $^{\circ}$	
100	6-6-79	1350	99.67	9.6	233 $^{\circ}$	072 $^{\circ}$	
101		1450	100.67	7.4	227 $^{\circ}$	060 $^{\circ}$	0.6
102		1550	101.67	5.0	220 $^{\circ}$	040 $^{\circ}$	
103		1650	102.67	3.5	221 $^{\circ}$	005 $^{\circ}$	0.1
109	6-6-79	2238	108.47	2.0	273 $^{\circ}$		
Berg No. 2							
00	2-6-79	1010h	0.0	5.4	255 $^{\circ}$	160 $^{\circ}$	Negligible
100	6-6-79	1350	99.67	5.2	252 $^{\circ}$	005 $^{\circ}$	0.1
109	6-6-79	2238	108.47	5.0	288 $^{\circ}$		

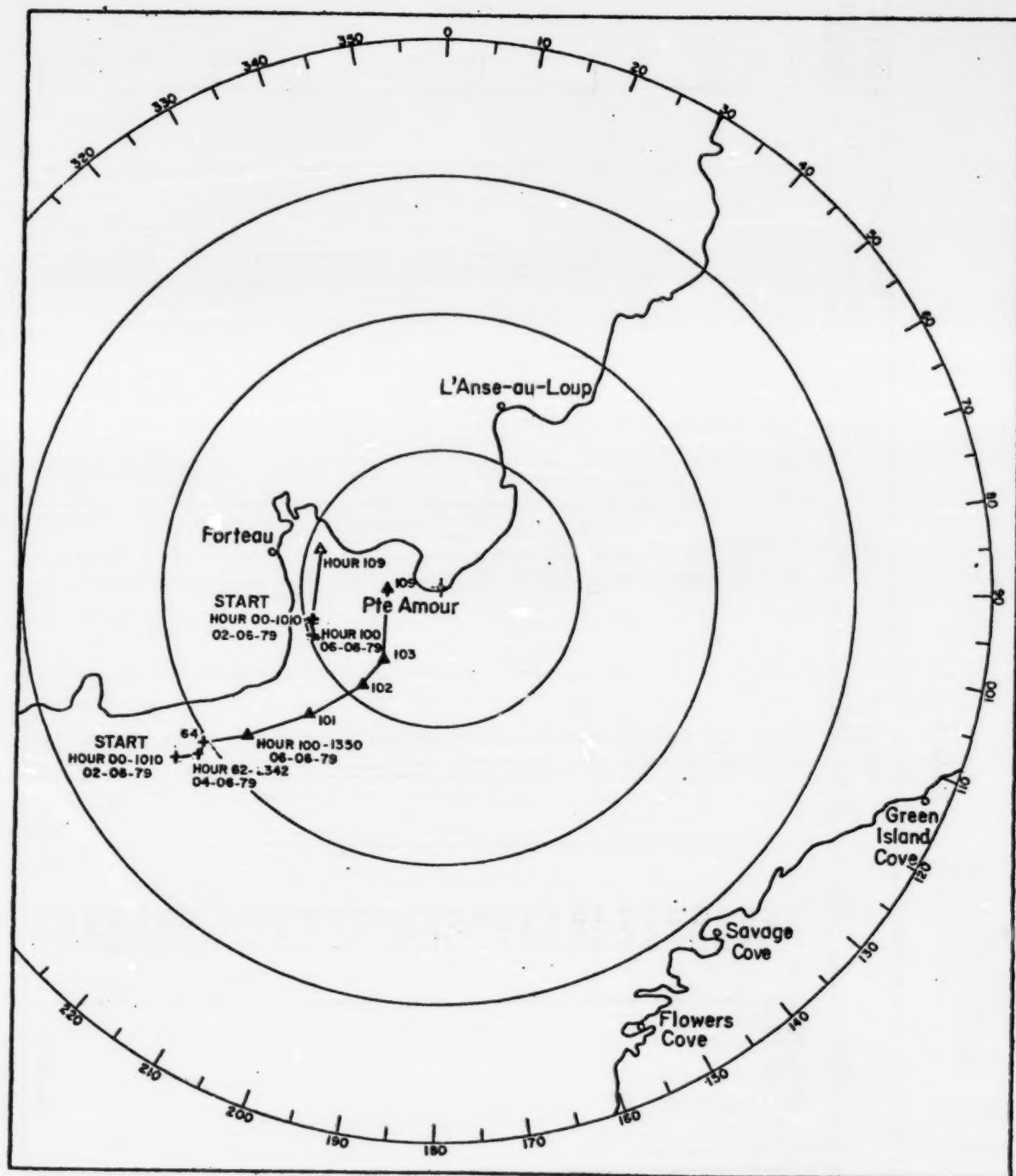


Figure 6 Trajectories of two medium bergs (Berg No. 1 and Berg No. 2) June, 1979. Distance from Pointe Amour to azimuth ring twelve nautical miles (approx. 22 km). Inner rings spaced at three nautical mile (approx. 5.5 km) intervals.

Berg No. 3

Table 5

Point Plotted	Date	Time	Elapsed Time (hours)	Range (km)	Bearing (°T)	Average Direction (°T)	Average Velocity (m/s)
00	22-8-79	2244 h	0.00	21.1	050	225	0.9
01	23-8-79	2344	1.0	17.2	051	208	
02		0044	2.0	13.0	059	216	
03		0144	3.0	11.1	063	221	
04		0244	4.0	9.1	068	184	
05		0344	5.0	8.7	072	112	0.2
06		0444	6.0	9.1	073	065	
07		0544	7.0	9.6	072	077	
08		0644	8.0	10.6	073	139	
09		0744	9.0	11.1	078	201	
10		0844	10.0	10.4	085	220	0.7
11		0944	11.0	9.1	093	247	
12		1044	12.0	7.2	100	238	
13		1144	13.0	5.6	118	263	0.3
14		1244	14.0	4.4	129	329	
15		1344	15.0	3.7	122	028	0.7
16		1444	16.0	4.1	093		
17		1544	17.0	6.1	070	035	
18		1644	18.0	8.9	058	042	
19		1744	19.0	11.5	054	051	
20		1844	20.0	13.5	053	063	0.2
21		1944	21.0	13.9	054	228	
22		2044	22.0	12.8	055	225	
23		2144	23.0	11.1	056	221	0.6
24		2244	24.0	8.5	061	226	
25		2344	25.0	6.1	067		
26	24-8-79	0044	26.0	4.4	076		
27		0144	27.0	3.0	092	229	
28		0244	28.0	1.5	107	258	
29		0344	29.0	1.3	062	352	
30		0444	30.0	2.4	057	052	0.3
31	24-8-79	0544	31.0	3.5	053	045	

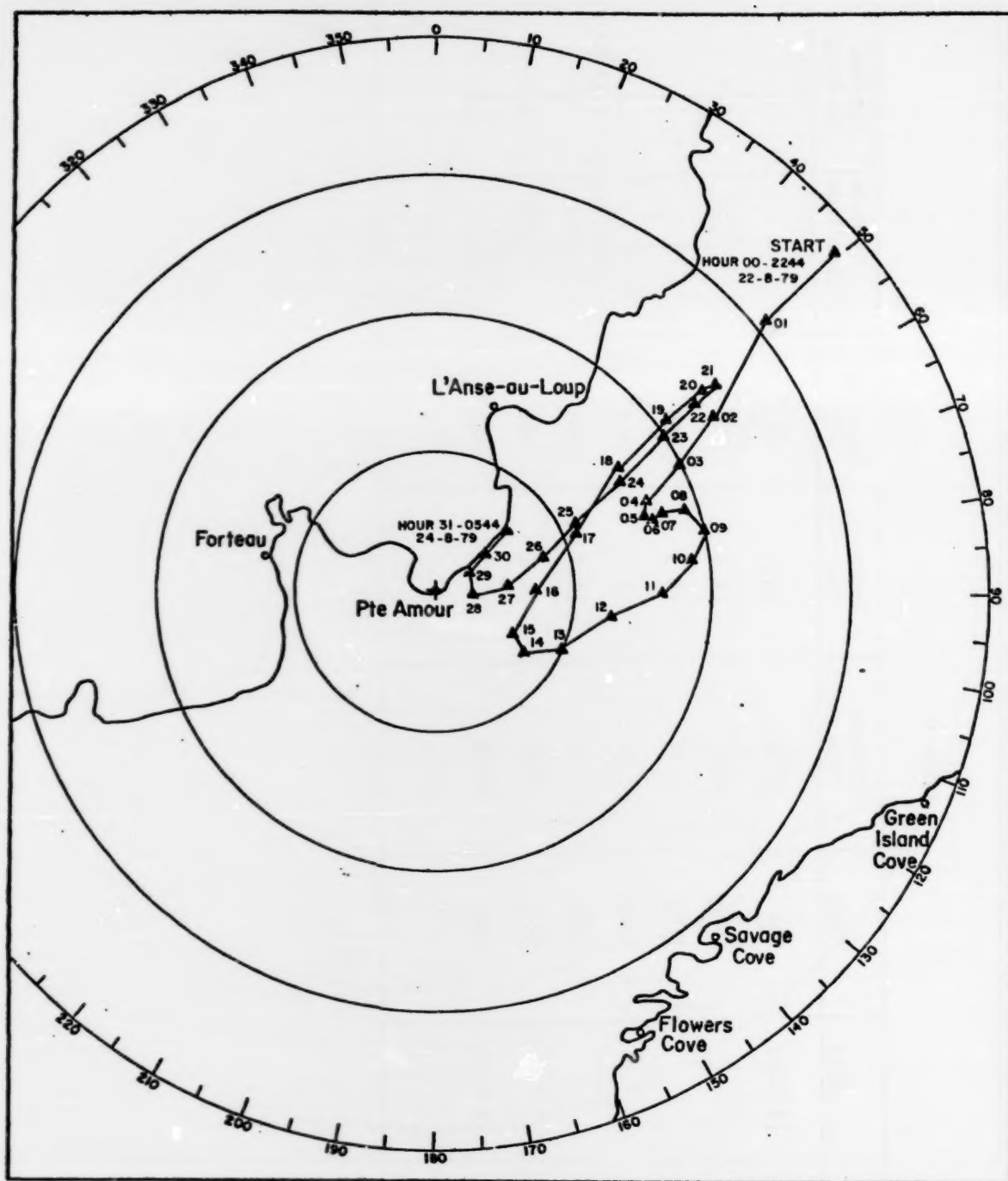


Figure 7 Trajectory of Berg No. 3 detected August 22, 1979. This berg broke into two pieces at position 08 on this figure. The smaller echo faded shortly after the break.

Berg No. 4

Table 6

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing ($^{\circ}$ T)	Average direction ($^{\circ}$ T)	Average Velocity (m/s)
00	16-5-80	0941 h	0.00	15.2	062 $^{\circ}$	200 $^{\circ}$	0.3
0.9		1034	0.88	14.8	064 $^{\circ}$		
1.4		1103	1.37	14.3	066 $^{\circ}$		
2.1		1146	2.08	13.7	068 $^{\circ}$	Stationary	5.22 hours
7.3		1659	7.30	13.7	068 $^{\circ}$		
7.6		1720	7.65	14.6	065 $^{\circ}$	035 $^{\circ}$	0.6
8.2	16-5-80	1752	8.18	15.6	064 $^{\circ}$		

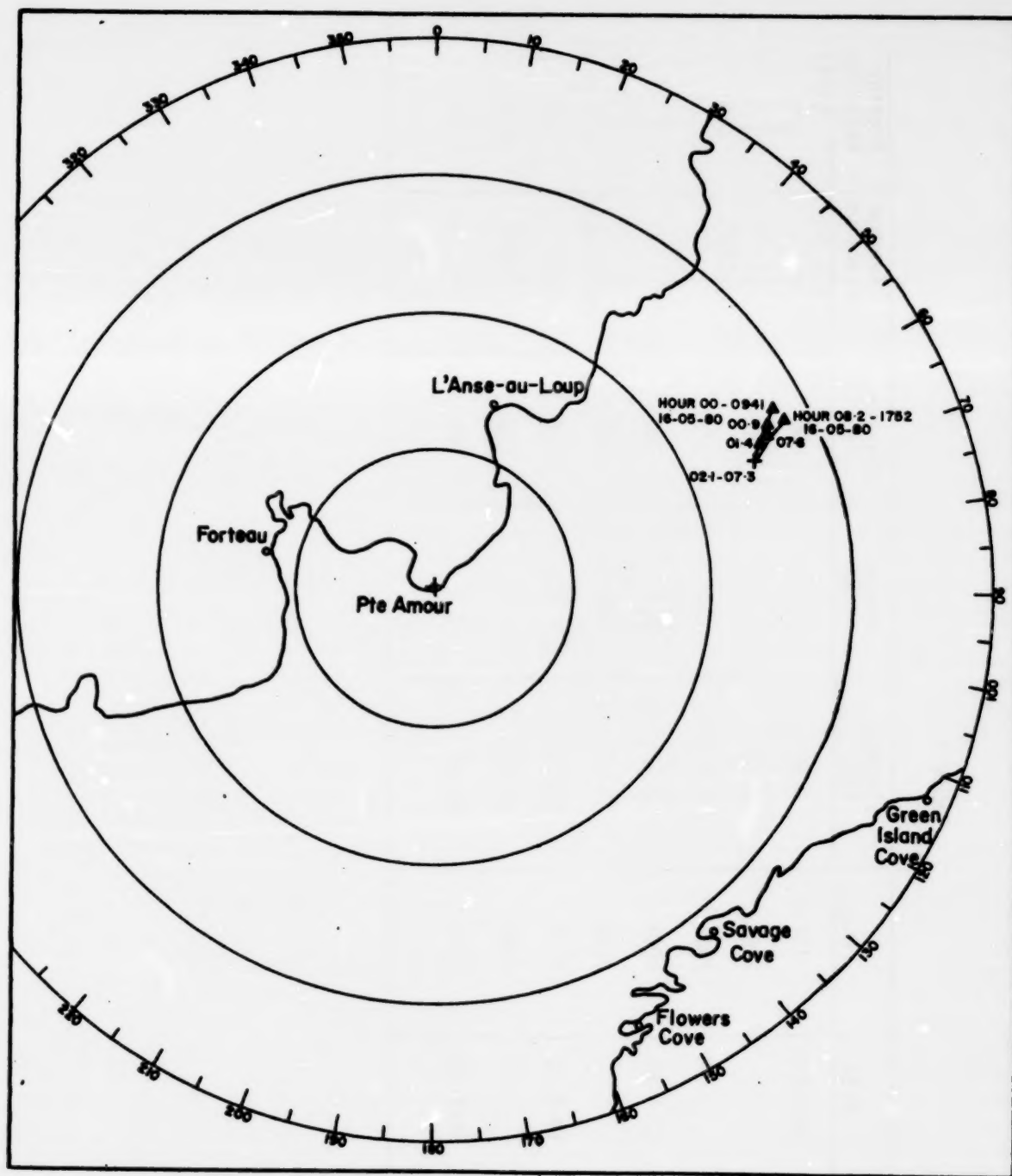


Figure 8 Trajectory of Berg No. 4 detected May 16, 1980. Grounding appears to have occurred on the edge of the Centre Bank in 55 m of water.

Berg No. 5

Table 7

Point Plotted	Date	Time	Elapsed Time (hours)	Range (km)	Bearing (°T)	Average Direction (°T)	Average Velocity (m/s)
00	16-5-80	2154 h	0.00	13.5	066	(0°)	
01		2200	0.10	13.0	067	222°	0.9
02		2301	1.12	10.2	073		
03	17-5-80	0001	2.12	7.0	088		
63		0106	3.20	5.6	116	Stationary	2.5 days
64	19-5-80	1311	63.28	5.6	116		
65	19-5-80	1400	64.10	5.9	110	050°	0.3
		1522	65.47	7.0	096		

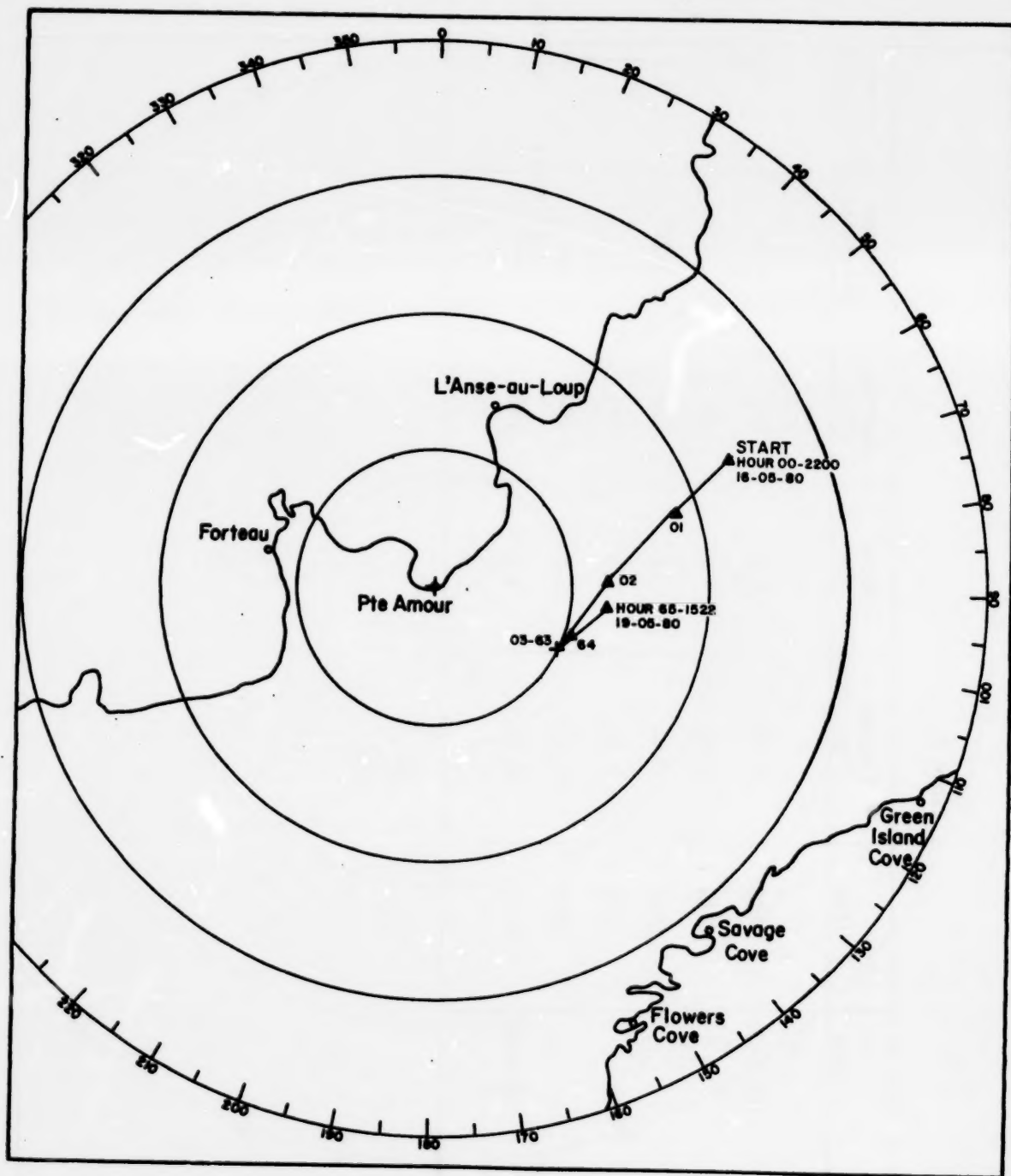


Figure 9 Trajectory of Berg No. 5 detected May 16, 1980. Grounding appears to have occurred in 55 m of water.

Berg No. 6

Table 8

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (°T)	Average Direction	Average Velocity
00	26-5-80	0603	0.00	7.0	072	228°	0.9
01		0701	0.97	3.9	091		
02		0804	2.02	2.8	156		
03		0901	2.97	5.0	194		
03.4		0925	03.37	5.6	199		
05	26-5-80	1107	05.07	5.6	199	Stationary	1.7 hours

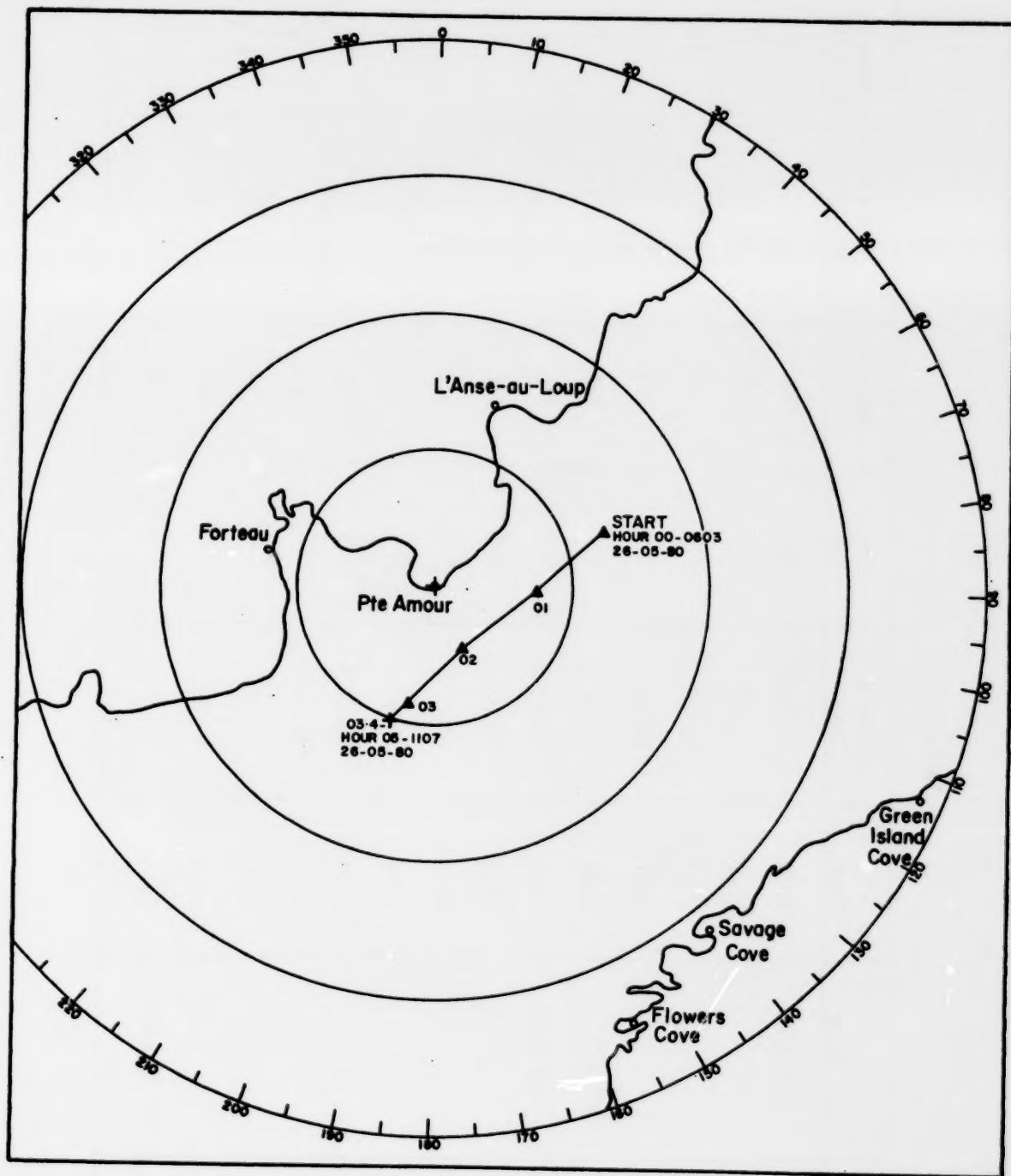


Figure 10 Trajectory of Berg No. 6 detected May 26, 1980. Water depths in the area of grounding range from 55 to 58 m.

Berg No. 7

Table 9

Point Plotted	Date	Time	Elapsed Time	Range (km)	Bearing (OT)	Average Direction	Average Velocity
00	27-5-80	1920 h	0.00	5.6	048	237°	0.8
01		2020	01.00	2.2	065		
02		2123	02.05	2.2	212		
03		2221	03.02	5.4	229		
04	28-5-80	2324	04.07	6.5	236	029°	0.3
05		0020	05.0	5.9	240		
06		0123	06.05	4.8	246		
07		0220	07.0	4.1	255		
08		0324	08.07	2.8	260		
08.7		0403	08.72	2.2	261		
15.7		1104	15.73	2.2	261		
16		1123	16.05	1.7	247		
17	28-5-80	1225	17.08	1.3	191	078°	0.4
17.6		1257	17.62	1.3	156		

7.02 hours

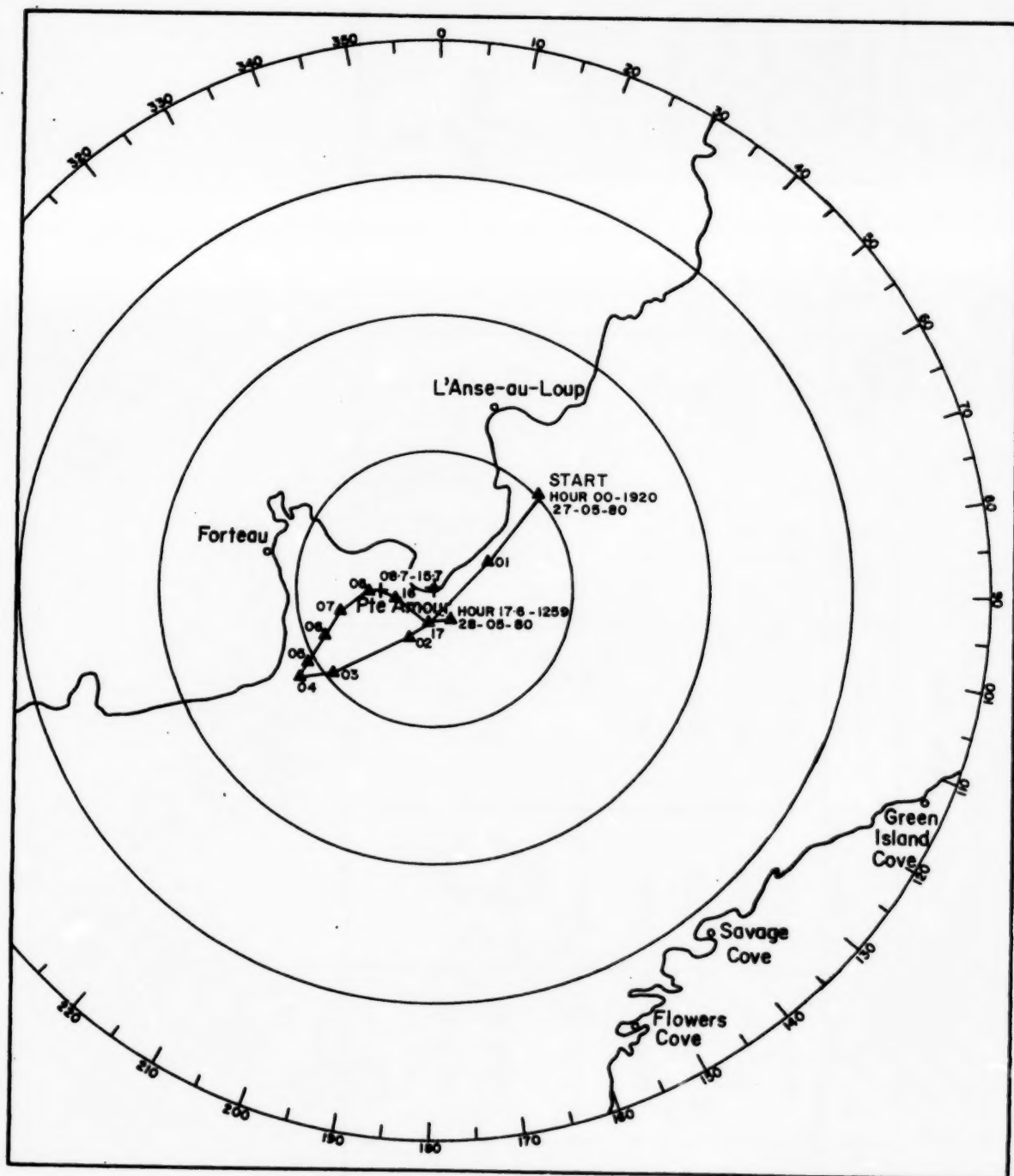


Figure 11 Trajectory of Berg No. 7 detected May 27, 1980. Water depths in the area of grounding drop fairly rapidly from 55 to 37 m.

Berg No. 8

Table 10

Point Plotted	Date	Time	Elapsed Time	Range (km)	Bearing (°T)	Average Direction (°T)	Average Velocity (m/s)
00	27-5-80	1355	0.00	8.9	230°	088°	Negligible
50	29-5-80	1613	50.30	7.8	228°		
55	29-6-80	2030	54.58	9.4	228°	225°	Stationary 4.89 days
117	01-6-80	1041	116.76	9.4	228°		Negligible
Berg No. 9							
00	29-5-80	1431	00.00	4.8	134°	—	Stationary 2.84 days
68	01-6-80	1041	68.17	4.8	134°	—	

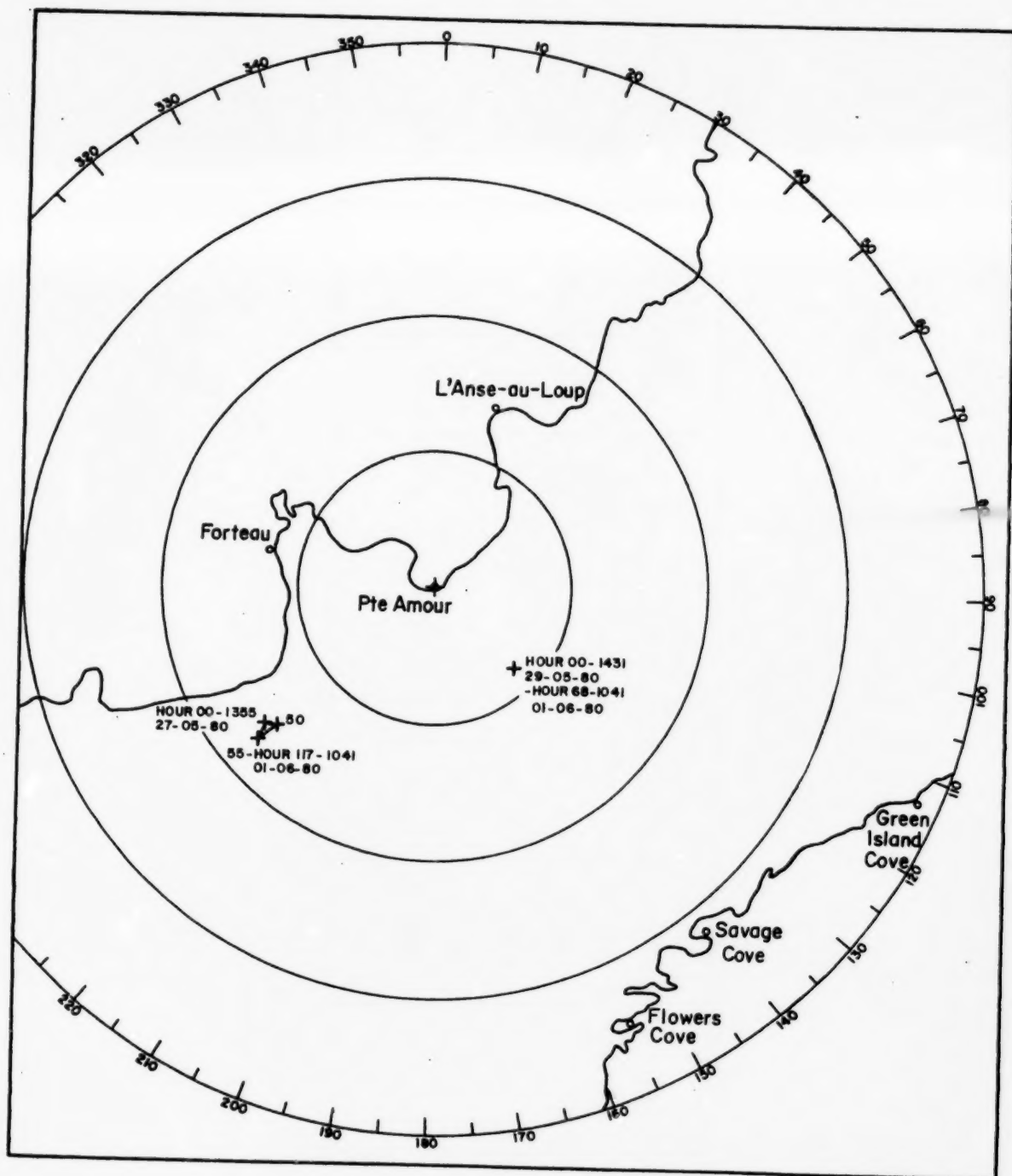
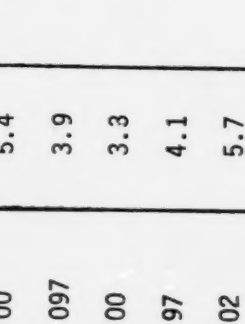
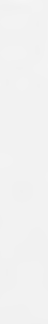


Figure 12 Positions of grounded Bergs No. 8 and No. 9 detected May 27 and 28, 1980. The bergs were stationary throughout the film record. They appeared to be grounded in 49 to 55 m of water.

Target 1

Table 11

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (T)	Average Direction	Average Velocity
00	19-5-80	0102 h	0.00	5.4	050		
01		0200	0.097	3.9	063		
02		0302	02.00	3.3	075		
03		0400	2.97	4.1	074		
04	19-5-80	0503	4.02	5.7	059		

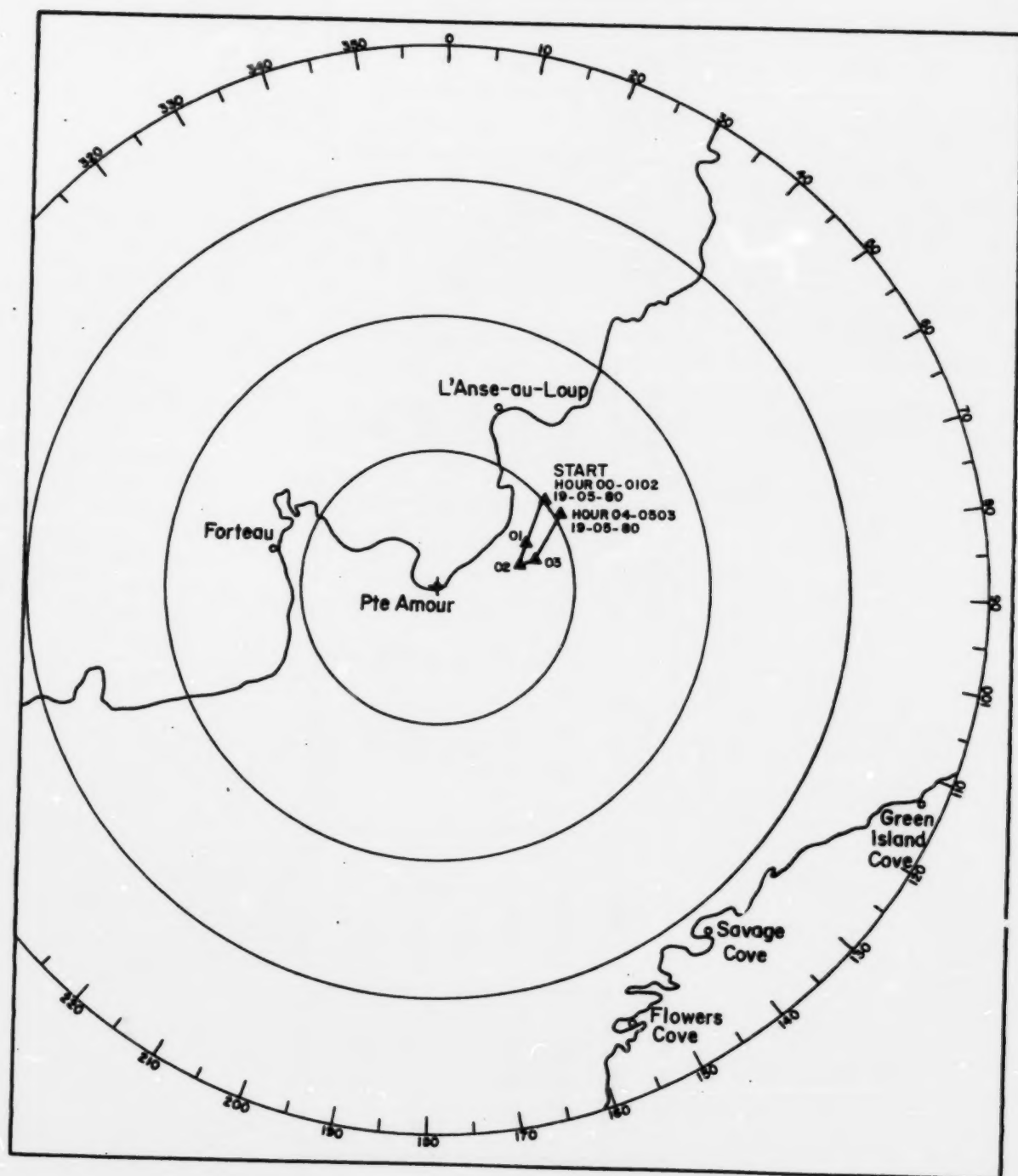


Figure 13 Trajectory of Target 1 detected May 19, 1980.

Target 2

Table 12

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (OT)	Average Direction (°T)	Average Velocity (m/s)
00	20-5-80	2248 h	00.00	9.3	065	225°	0.9
1.3	21-5-80	0004	1.27	6.7	076		
2.2		0101	2.22	4.4	096		
3.2		0200	3.20	3.7	155		
4.2	21-5-80	0301	4.22	6.3	194		

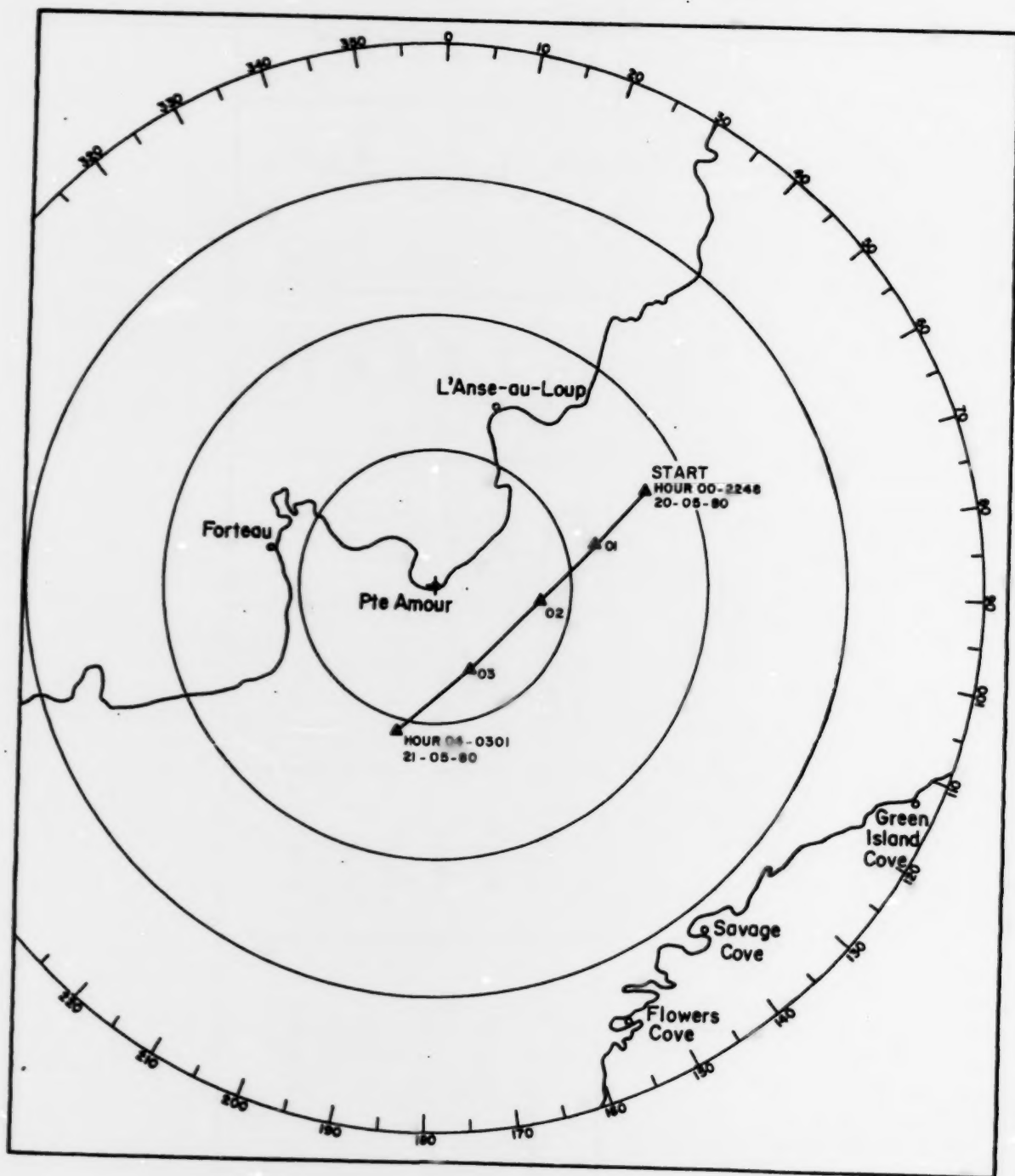


Figure 14 Trajectory of Target 2 detected May 20, 1980.

Target 3

Table 13

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (OT)	Average Direction (OT)	Average Velocity (m/s)
00	21-5-80	0430 h	0.00	4.1	060	193°	0.4
0.6		0504	0.57	4.3	069		
1.5		0602	1.53	4.1	081	069°	0.3
2.6		0705	2.58	5.0	080		
03	21-5-80	0734	3.07	5.7	078		

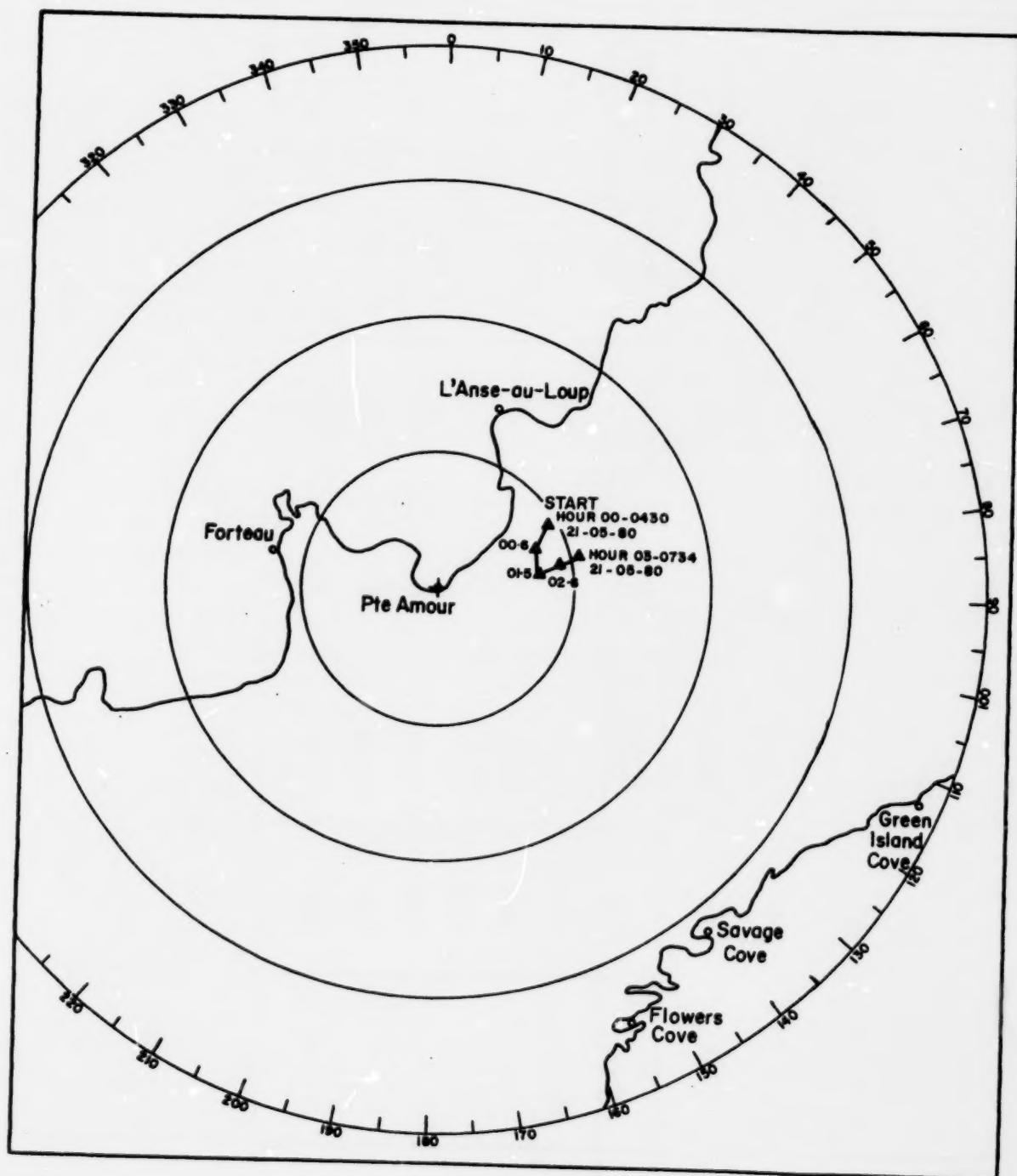


Figure 15 Trajectory of Target 3 detected May 21, 1980.

Target 4

Table 14

Point Plotted	Date	Time	Elapsed Time(hrs)	Range (km)	Bearing (OT)	Average Direction (OT)	Average Velocity (m/s)
00	21-5-80	1708 h	0.00	8.2	224	046°	0.8
01		1806	0.97	5.7	224		
02		1900	1.87	2.96	221		
03		2004	2.93	0.93	120		
04		2102	3.90	3.7	061		
05	21-5-80	2201	4.88	6.1	049		

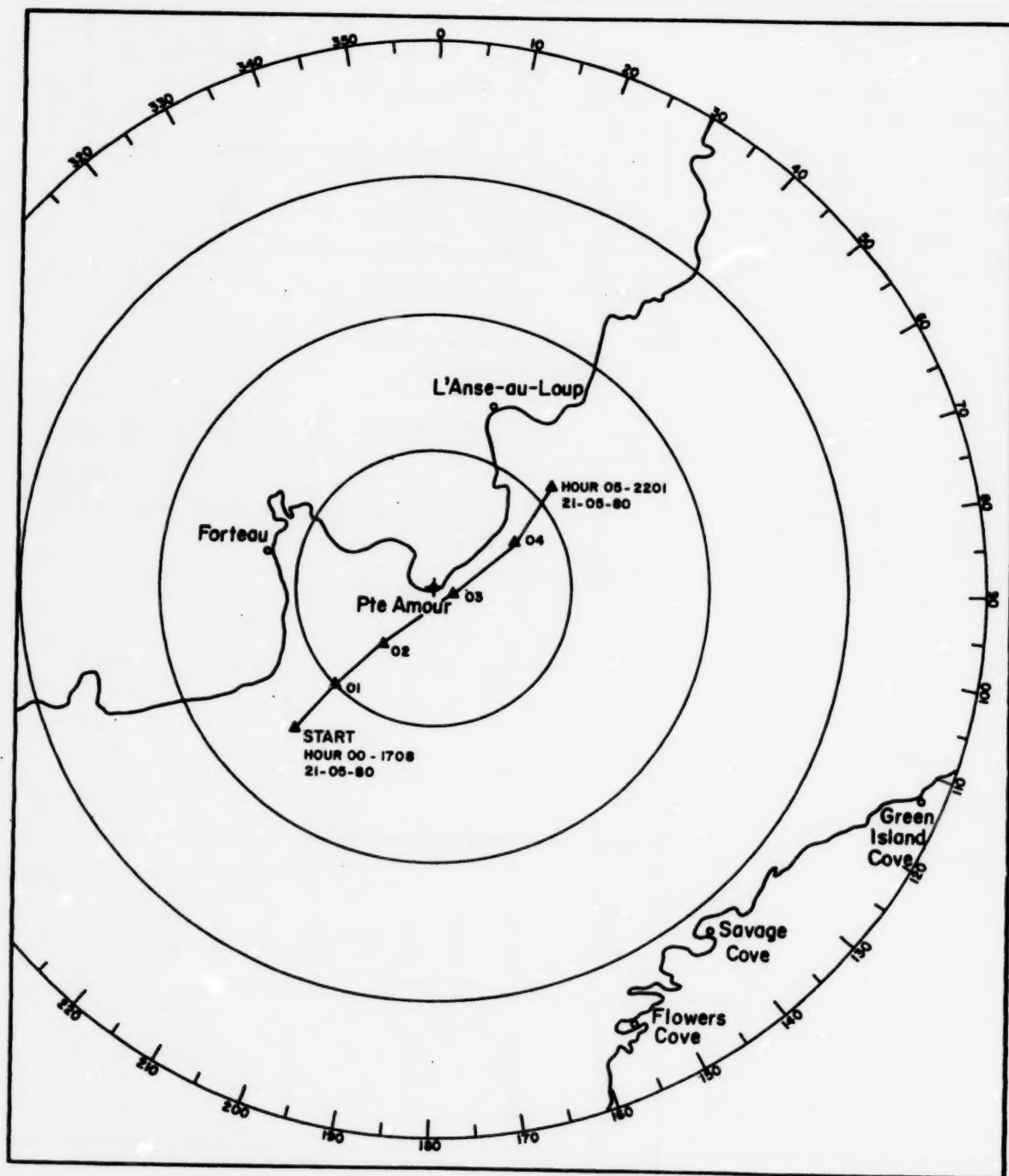


Figure 16 Trajectory of Target 4 detected May 21, 1980.

Target 5

Table 15

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (OT)	Average Direction (OT)	Average Velocity (m/s)
00	25-5-80	2233	0.00	7.6	051	219°	0.6
01		2331	0.97	5.0	056		
02	26-5-80	0033	2.0	2.6	069	240°	0.6
03		0132	2.98	1.9	100		
04		0234	4.02	1.7	150		
05		0333	5.0	2.4	192		
06	26-5-80	0435	6.03	4.1	213	240°	0.6
07		0529	6.93	6.3	223		
7.6		0608	7.58	8.2	228		

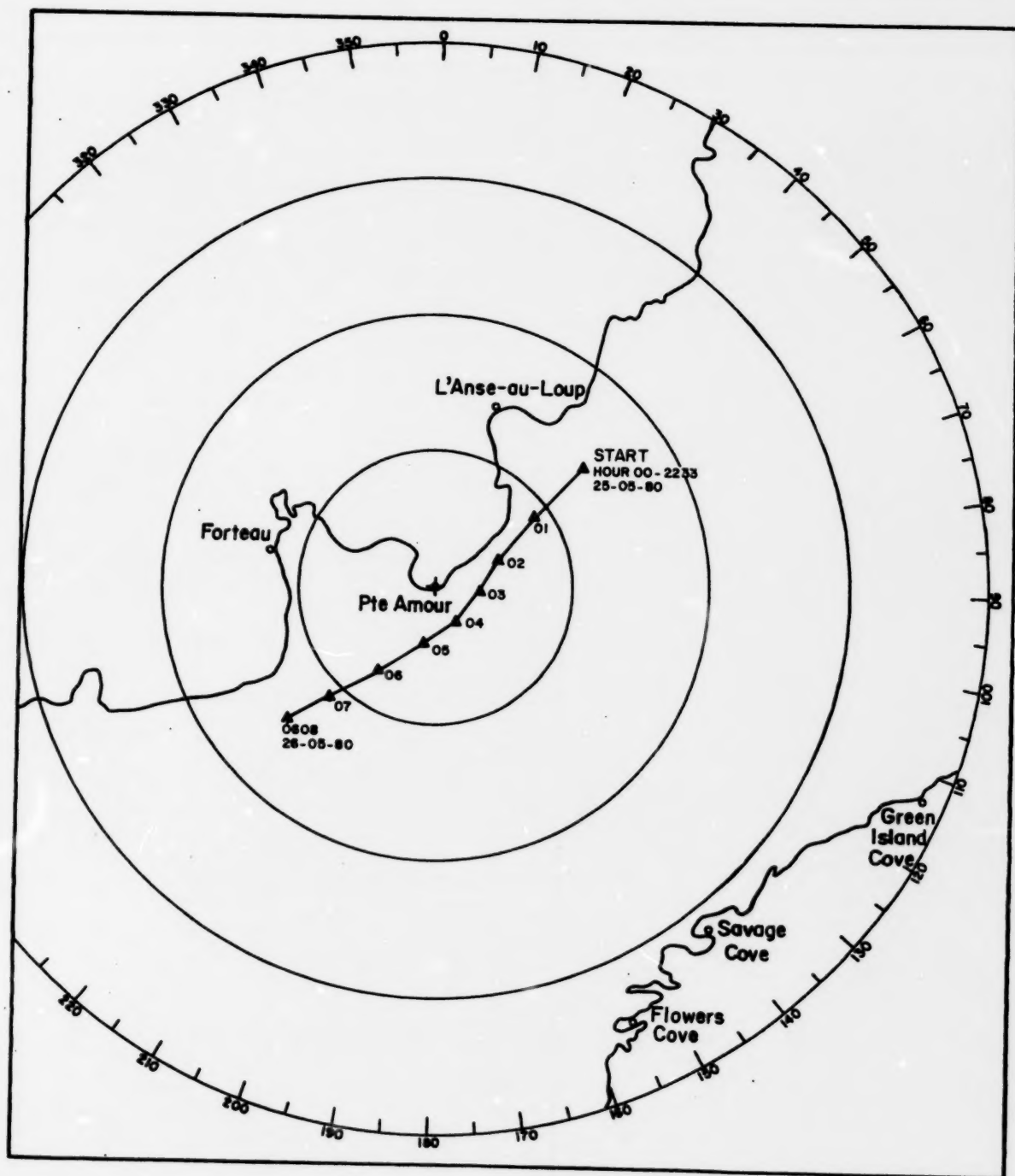


Figure 17 Trajectory of Target 5 detected May 25, 1980.

Target 6

Table 16

Point Plotted	Date	Time	Elapsed Time	Range (km)	Bearing (OT)	Average Direction	Average Velocity (m/s)
00	27-5-80	1359 h	0.00	3.5	145	(OT)	(m/s)
01		1458	0.98	4.1	132	076°	0.3
02		1555	1.93	4.6	132	133°	0.1
03		1704	3.08	4.9	139	214°	0.3
04	27-5-80	1748	3.82	5.2	152		

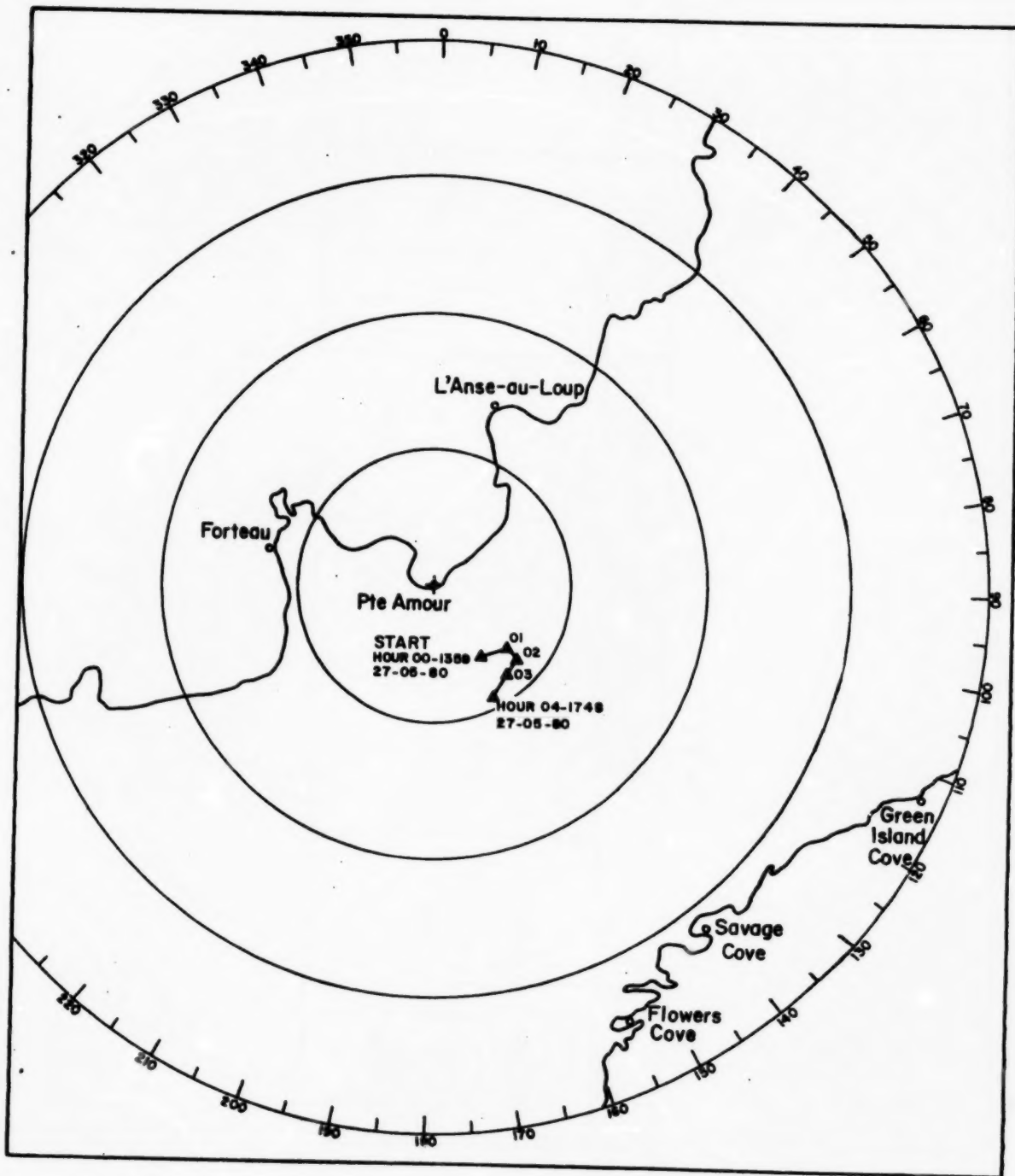


Figure 18 Trajectory of Target 6 detected May 27, 1980.

Target 7

Table 17

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (OT)	Average Direction (°T)	Average Velocity (m/s)
00	27-5-80	1704 h	0.00	8.3	053	203° 230°	1.3
01		1807	1.05	4.4	094		
02		1900	1.93	3.0	139		
03	27-5-80	2003	2.98	5.4	195		

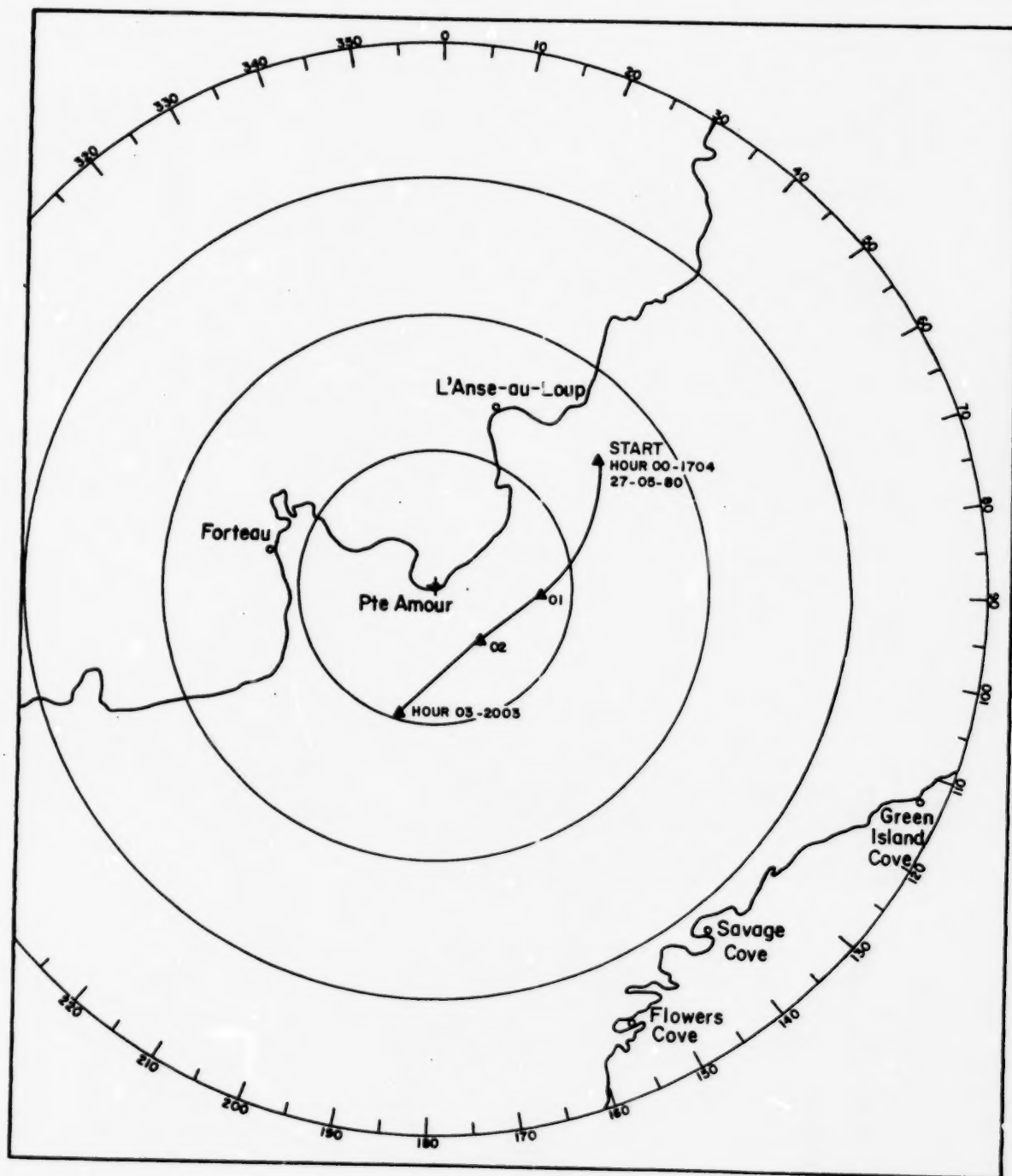


Figure 19 Trajectory of Target 7 detected May 27, 1980.

Target 8

Table 18

Point Plotted	Date	Time	Elapsed Time	Range (km)	Bearing (OT)	Average Direction (OT)	Average Velocity (m/s)
00	27-5-80	1807 h	0.00	6.9	052°	230°	0.9
01		1900	0.88	4.8	057°		
02		2003	1.93	1.1	084°		
03		2103	2.93	3.0	227°		
-		2142	3.58	4.4	235°		
05	27-5-80	2303	4.93	5.6	259°	355°	0.4
06		0015	6.13	5.7	279°		
-		0049	6.70	5.7	274°		
07.7	27-5-80	0147	7.67	5.4	276°	078°	

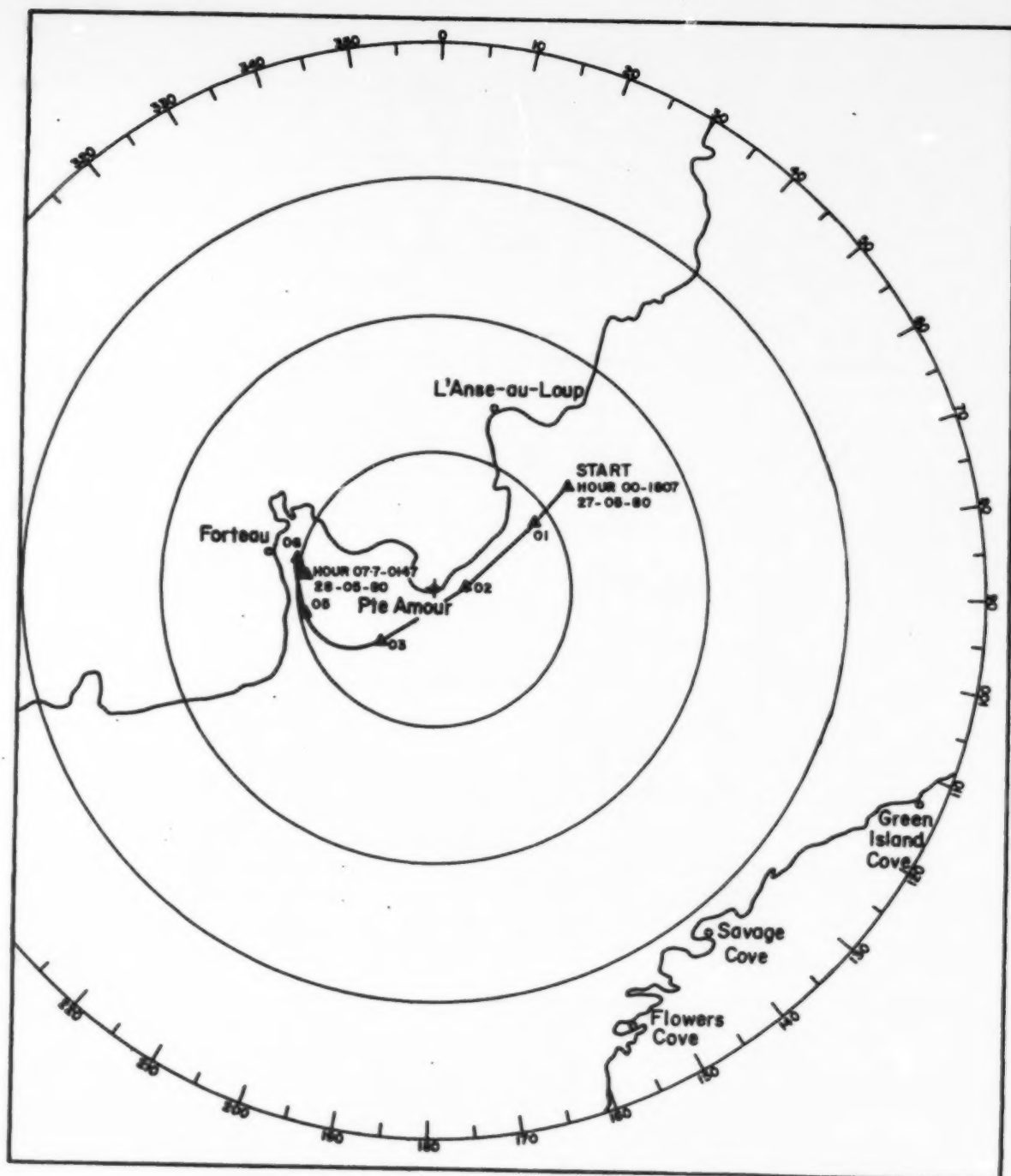
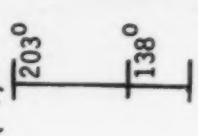
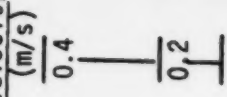


Figure 20 Trajectory of Target 8 detected May 27, 1980.

Target 9

Table 19

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (OT)	Average Direction (OT)	Average Velocity (m/s)
00	28-5-80	0912 h	0.00	8.9	063	 203°	 0.4
01		1002	0.83	7.4	070		
02		1104	1.87	6.9	080		
03	28-5-80	1230	3.30	7.6	088	 138°	 0.2

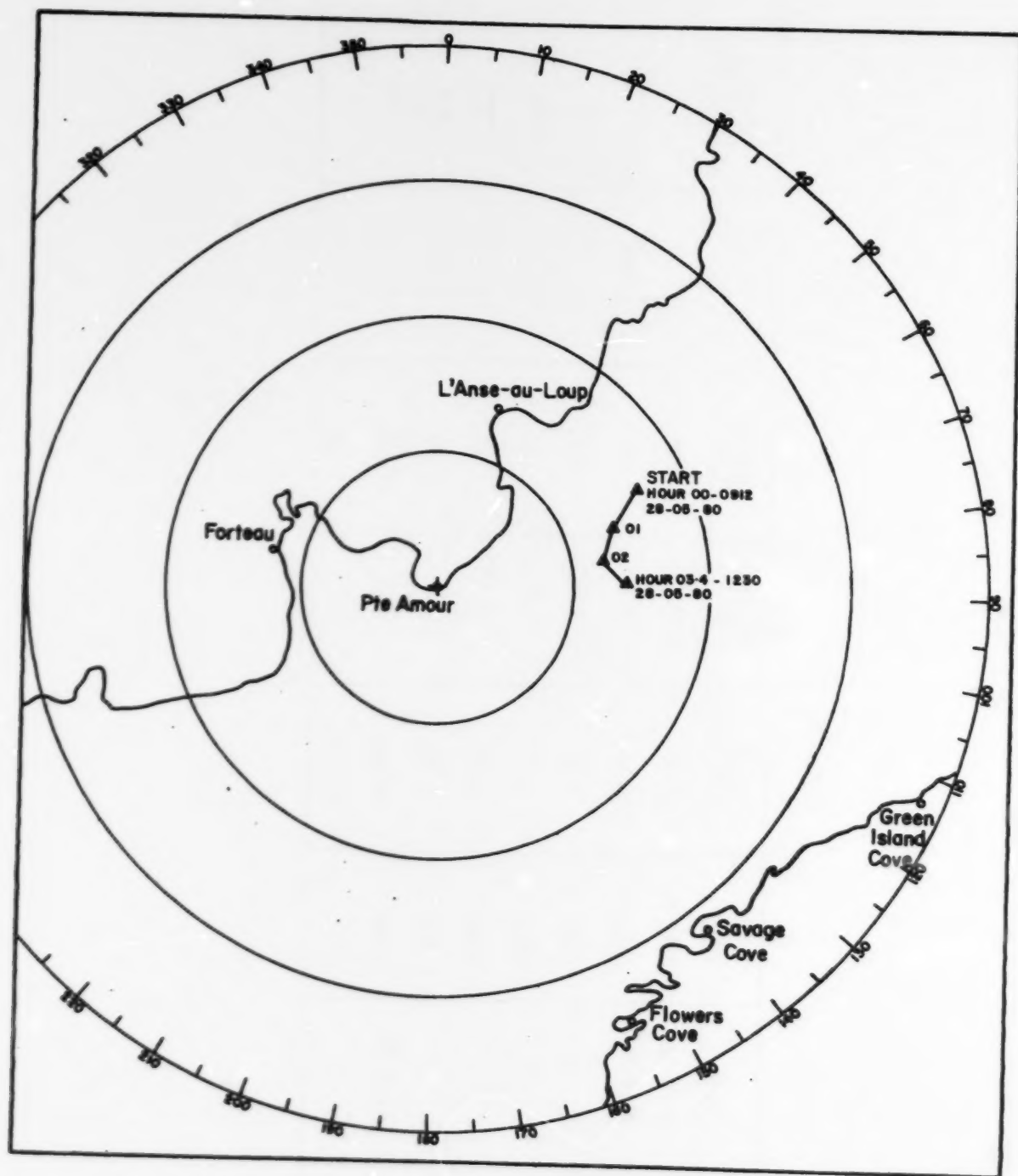


Figure 21 Trajectory of Target 9 detected May 28, 1980.

Target 10

Table 20

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (θ_T)	Average Direction (θ_T)	Average Velocity (m/s)
00	31-5-80	2345 h	00.00	10.7	095	245°	0.7
01	31-5-80	0009	00.40	9.5	100		
02		0104	1.32	7.8	111		
03		0201	2.27	6.5	120	041°	0.6
04		0301	3.27	6.1	114		
05	31-5-80	0403	4.30	6.9	094		
		0440	4.92	8.5	085		

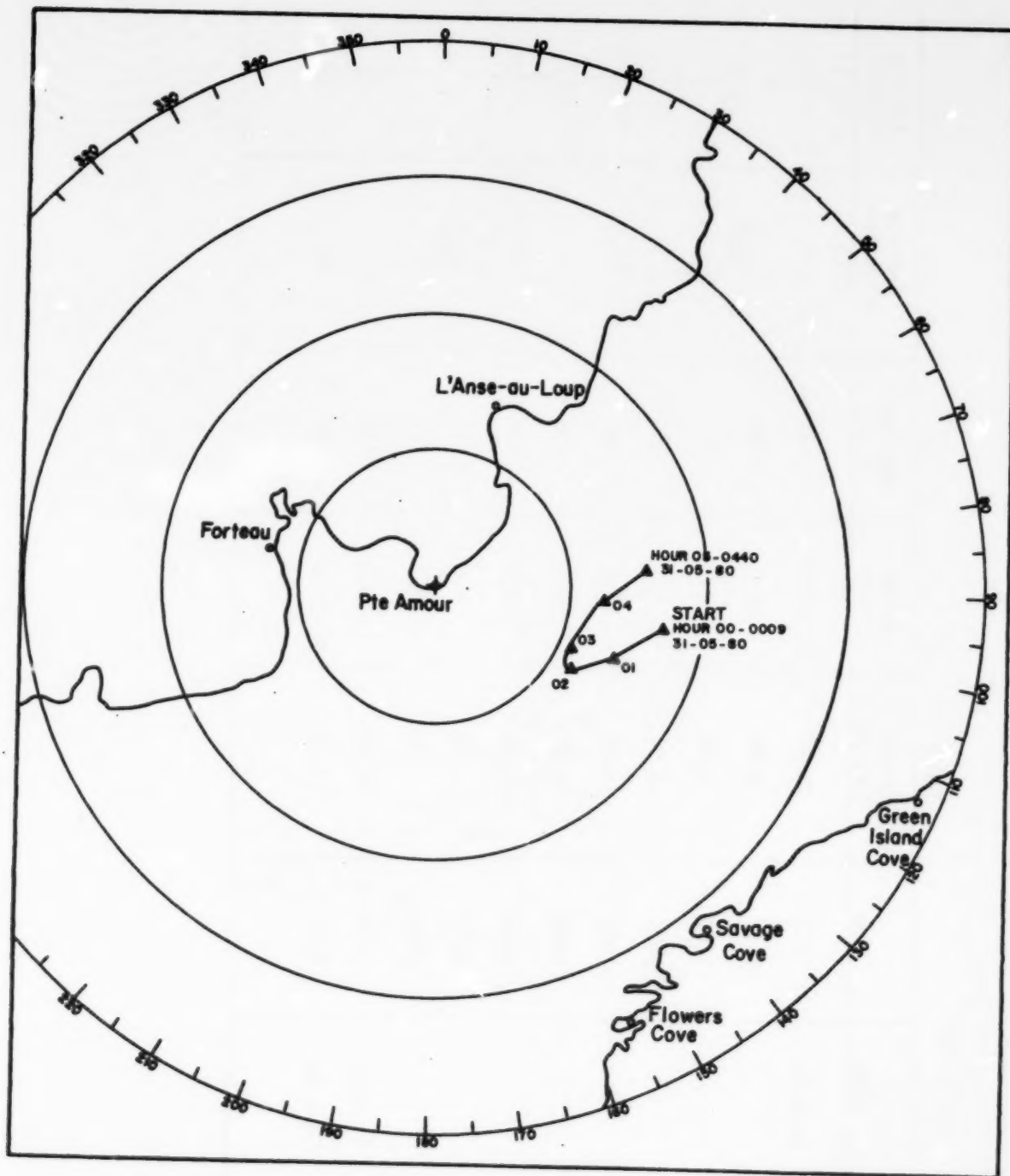


Figure 22 Trajectory of Target 10 detected May 31, 1980.

Target 11

Table 21

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (OT)	Average Direction (OT)	Average Velocity (m/s)
00	31-5-80	1510 h	00.00	12.6	192	047°	0.7
01		1613	1.05	10.6	185		
02		1701	1.85	8.9	177		
03		1804	2.90	7.6	160		
04		1902	3.87	7.4	144	223°	0.2
05		2000	4.83	7.9	138		
06		2103	5.88	8.2	144		
07	01-6-80	2215	7.08	9.1	160	0.6	
08		2309	7.98	10.2	172		
10		0115	10.08	13.2	180		
10.7		0151	10.68	14.5	189		

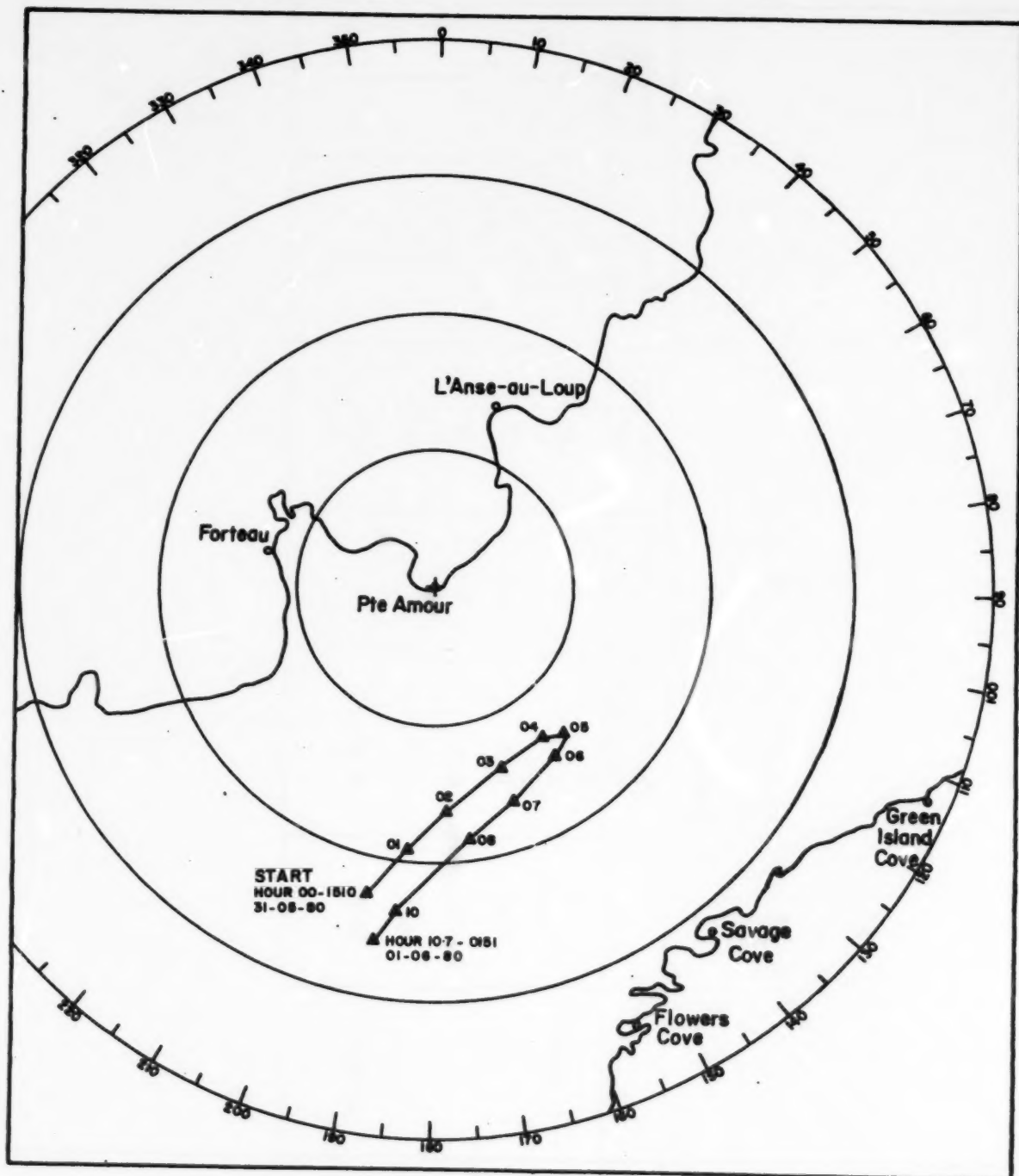


Figure 23 Trajectory of Target 11 detected May 31, 1980.

Target 12

Table 22

Point Plotted	Date	Time	Elapsed Time (hrs)	Range (km)	Bearing (OT)	Average Direction (OT)	Average Velocity (m/s)
00	01-6-80	0527 h	0.00	8.0	159	052°	0.8
01		0630	1.05	8.0	126		
02		0732	2.08	9.8	104		
03		0831	3.07	11.1	096		
04	01-6-80	0929	4.03	12.0	092		

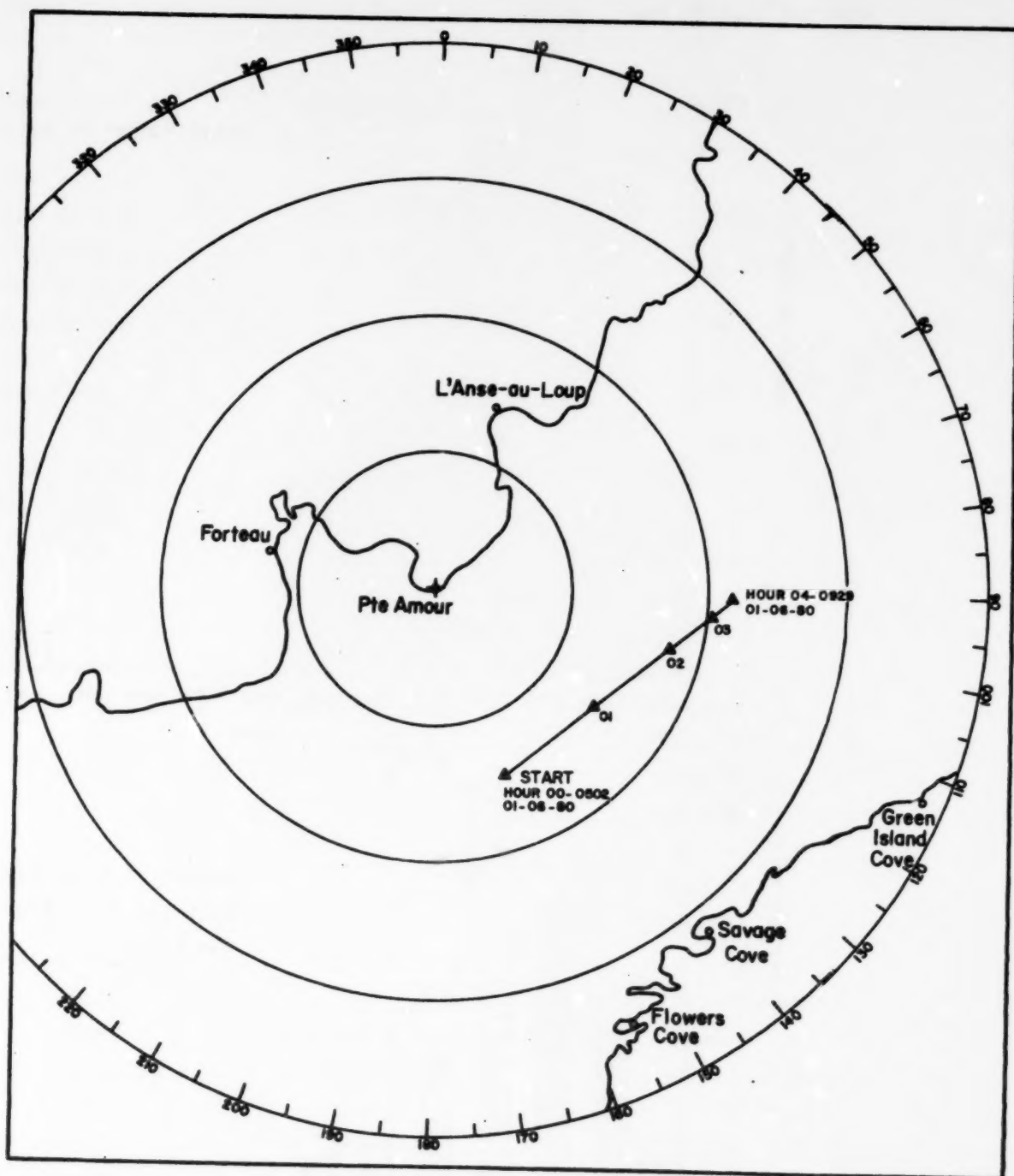


Figure 24 Trajectory of Target 12 detected June 1, 1980.

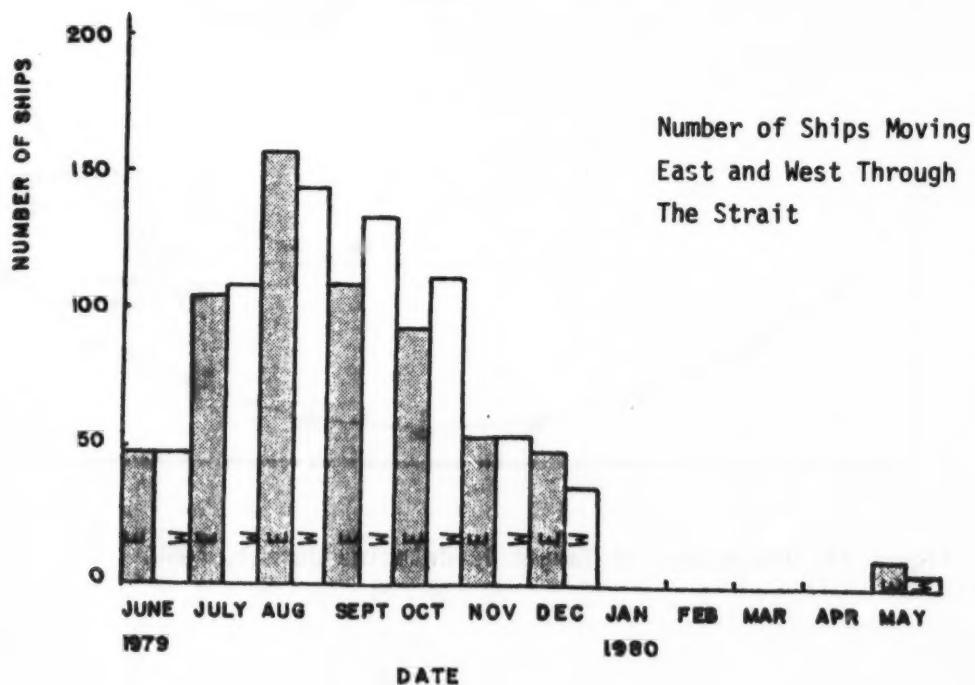
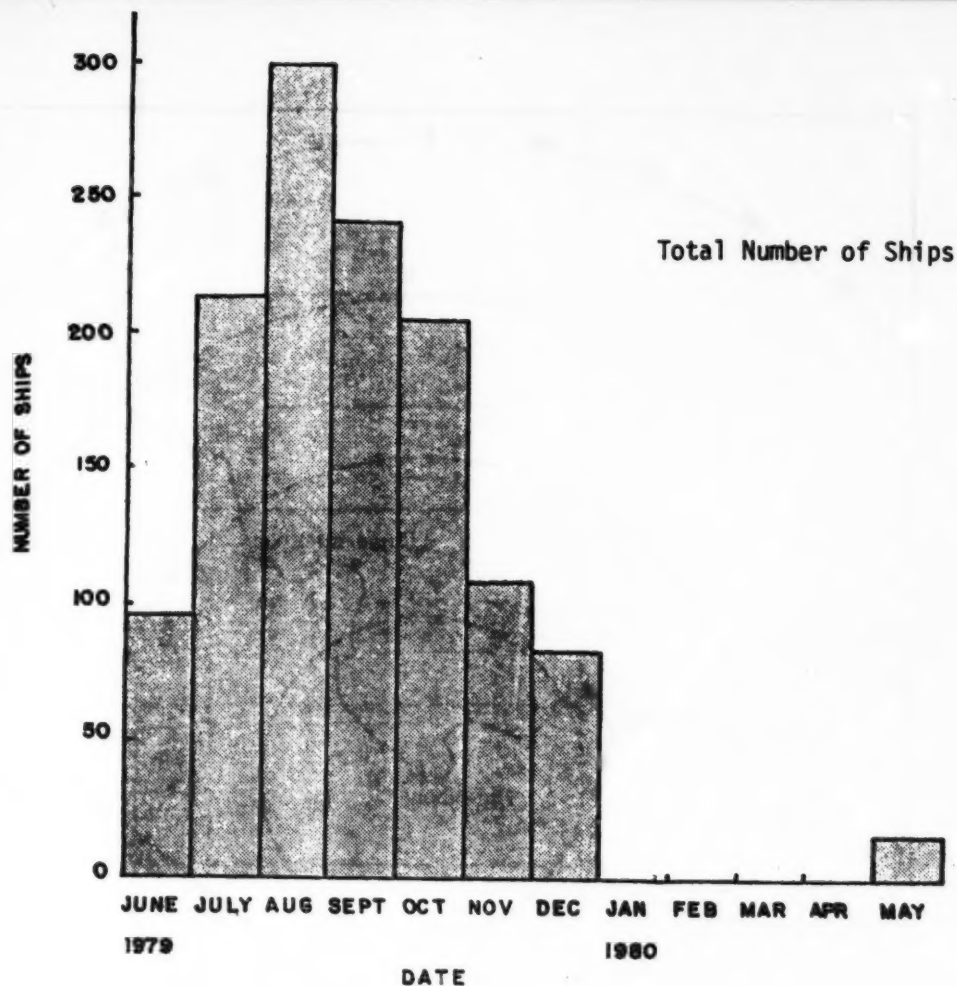


Figure 25 Monthly Shipping Summary.

Table 23: Summary of Iceberg Sightings. June 02, 1979 to June 01, 1980

IDENTIFICATION	VISUAL SIGHTING	RADAR SIGHTING
1979		
Medium Berg	June 02	June 02-06
Medium Berg	June 02	June 02-06
Medium Berg	June 02	--
Medium Berg	June 02	--
Small Berg	August 23/24	August 22-24
Small Berg	August 23/24	
1980		
Small Berg	February 28	--
Small Berg	March 03	--
Berg	--	May 16
Berg	--	May 16-19
Target	--	May 19
Target	--	May 20-21
Target	--	May 21
Target	--	May 21
Target	--	May 25/26
Berg	--	May 26
Target	--	May 27
Target	--	May 27
Target	--	May 27
Medium Berg	May 28	--
Berg	--	May 27-June 01
Target	--	May 28
Berg	June 01	May 29-June 01
Target	--	May 30-June 01
Target	--	May 31-June 01
Target	--	June 01

MAY 15	16	17	18	19	20	21	22	23
	B4 ■							
	B5 ■							
			T1 ■					
					T2 ■			
					T3 ■			
						T4 ■		
MAY 24	25	26	27	28	29	30	31	JUNE 01
	T5 ■							
	B6 ■							
			B8 ■					
			T6 ■					
			T7 ■					
			T8 ■					
			B7 ■					
				T9 ■				
					B9 ■			
						T10 ■		
							T11 ■	
								T12 ■

Table 24 - Iceberg sightings during May 1980

APPENDIX A

Specifications of FURUNO FR240 Mark II
and Decca RM 916A Radars

SPECIFICATIONS OF FR-240 MARK-II

ANTENNA UNIT

1. Type: 3 ft. center-fed slotted waveguide array.
2. Revolutions: 24 rpm
3. Wind Velocity: 70 knots.
4. Beam Width: 2.6° (HOR), 25° (VERT)
5. Sidelobe Attenuation: Within $\pm 10^\circ$ of main beam; 20 dB, Outside $\pm 10^\circ$ of main beam; 24 dB
6. Weight: 21 Kgs.
7. Ambient Temperature: -25° to $+70^\circ\text{C}$.

RF UNIT

1. Frequency: 9410 ± 30 MHz (X-band).
2. Peak Output Power: 3 KW nominal.
3. Pulse Length: 0.08 μs . (short ranges). 0.5 μs . (long ranges).
4. Pulse Repetition Rate: 1500 pps.
5. Mixer: Balanced type.
6. Local Oscillator: Gunn Diode.
7. Intermediate Frequency: 40 MHz, Band width; 6 MHz.
8. Tuning: Manual.
9. Modulator: Solid State.
10. T/R: Circulator with limiter
11. Amplifier: IC Linear Amplifier.

12. Video Band Width: 5 MHz.
13. Noise Factor: 10 dB nominal

DISPLAY UNIT

1. Picture Tube: 7" PPI Scope (12" presentation with magnifying lens).
2. Range Scales: Range 1/2, 1-1/2, 3, 6, 12, 24 n.m.
Ring Interval 1/4, 1/4, 1/2, 1, 2, 4 n.m.
3. Range Accuracy: Range ring accuracy within $\pm 1.5\%$ or 75 yards (70m) whichever is the greater.
4. Weight: 14 Kgs.
5. Ambient Temperature: -15° to $+55^\circ\text{C}$.

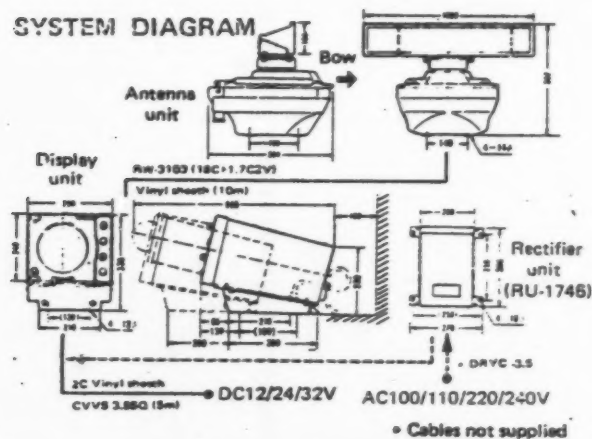
POWER SUPPLY

DC12/24/32V, 90W approx.
AC100/110/220/240V (with extra Rectifier Unit), 115VA

EQUIPMENT LIST

1. Display Unit 1
2. Antenna Unit 1
3. Installation Materials 1 set
Incl. 10m cable with plugs, viewing hood with magnifier.
4. Spare Parts 1 set
5. Rectifier Unit for AC 100/110/220/240V (option)

SYSTEM DIAGRAM



OPERATIONAL SPECIFICATION

RM914A, RM916A

RM926, RM929

Range		Pulse length (μs)	
Range scale (n.m.)	Range rings (n.m.)	7kW	25kW
0-25	0-05	—	—
0-5	0-25	0-25	—
0-75	0-25	0-25	—
1-5	0-25	0-25	—
3	0-5	0-75	1-0
6	1	0-75	1-0
12	2	0-75	1-0
24	4	0-75	1-0
48	8	0-75	1-0
60*	10	0-75	1-0

* Provided by an optional conversion kit as an alternative to 48n.m.

A further optional conversion kit provides ranges in statute miles up to 48 miles.

Minimum range: 15yd (13.6m) on 10m² target with 0.5μs pulse length, waveguide run of less than 15ft. (4.5m) and aerial height of 1.5ft. (25yd (23m) with 25kW transceiver).

Discrimination: 10yd (9.1m) on the 0.5n.m. range scale with 10m² target.

Range ring accuracy: Within 1-5% of the maximum of the range scale in use or 75yd (68.2m) whichever is the greater.

Variable range marker: Optional fitting.

Measurement: Continuous 200yd to 48n.m. or 60n.m. (or statute miles).

Accuracy: Within 1-5% of the maximum of the range scale in use or 75yd (68.2m), whichever is the greater.

Display

Cathode ray tube diameter: 9in. (229mm).

Effective viewing diameter: 7.5in. (190mm)

or 11.25in. (286mm) with optional magnifier.

Radar controls

Radar off - Scanner on - Standby - Short

pulse - Long pulse; Tuning; Gain;

Anti-clutter sea; Anti-clutter rain; Range;

Head-up - Heading marker off - North up;

Heading alignment; Illumination -

brilliance; Range ring brilliance.

Bearing

Accuracy: Better than 1°.

Heading marker accuracy: Within 0.5°.

Ancillary items

In addition to the variable range marker ancillary items include new performance monitor, azimuth stabiliser, reflection plotter, magnifier, stern marker kit, display pedestal, and table mount, and slave display.

TECHNICAL SPECIFICATION

Radar frequency

9415-9475MHz: 3cm-X band. (RM914/6A)

9380-9440MHz: (RM926/9)

Aerial system

End-fed slotted waveguide aerials 4ft.

(1.2m), 6ft. (1.8m) and 9ft.

(2.7m) aperture rotating at 28 r.p.m. (nominal)

with satisfactory operation at relative wind speeds up to 100 knots.

Horizontal beamwidth:

4ft. (RM914A)

Less than 1-9° at

half power points.

6ft. (RM916A,

RM926)

Less than 1-2° at

half power points.

Vertical beamwidth:

Approx. 20° at

half power points.

Approx. 20° at

half power points.

Sidelobes: Within ±10° of main beam

Better than 23dB. Better than 25dB.

Outside ±10° of main beam

Better than 30dB. Better than 32dB.

Aerial gain: With respect to an isotropic

radiator

Approx. 28dB.

Approx. 30dB.

Horizontal beamwidth:

9ft. (RM929)

Less than 0-8° at

half power points.

Vertical beamwidth:

Approx. 15° at

half power points.

Sidelobes: Within ±10° of main beam

Better than 25dB.

Outside ±10° of main beam

Better than 32dB.

Aerial gain: With respect to an isotropic

radiator

Approx. 33dB.

Transmitter characteristics

Magnetron peak power: 7kW or 25kW nominal.

P/L		PRF	
7kW	25kW	7kW	25kW
0-05μs	0-05μs	3400p.p.s	3300p.p.s
0-25μs	0-25μs	1700p.p.s	1650p.p.s
0-75μs	1-0μs	850p.p.s	825p.p.s

Pulse generator: Solid-state with pulse-forming network driving a magnetron.

Receiver characteristics

Type: Logarithmic with balanced mixer.

Tuning: Manual acquisition with automatic follow.

Tuning indicator: Magic eye i.f. indication.

Local oscillator: Solid-state.

I.F.: Centred on 60MHz.

I.F. bandwidth: 18MHz (0-05μs P/L)

5MHz (0-25, 0-75 or 1-0μs P/L).

Video bandwidth: 16 MHz nominal.

Noise factor: Better than 10dB.

Power

Input voltage	Consumption		Consumption	
	Min	Max	Min	Max
24Vdc	230W	290W	350W	410W
32Vdc	230W	290W	350W	410W
110Vdc	270W	330W	420W	480W
220Vdc	270W	330W	420W	480W
115V1φac	260W	320W	400W	460W
230V1φac	260W	320W	400W	460W
380V1φac	280W	320W	400W	460W
440V1φac	260W	320W	400W	460W

Minimum and maximum at zero and 100 knots relative wind loading without ancillaries.

COMPASS SAFE DISTANCES

Admiralty compass grade

Compass errors less than

Unit

Display	4-0ft (1220mm)
Scanner	3-5ft (1065mm)
Scanner with transceiver	8-0ft (2440mm)
Transceivers	11-0ft (3355mm)
Inverter	9-0ft (2745mm)
Rectifier	7-0ft (2135mm)
Converter (RM914A, 916A)	7-0ft (2135mm)
Converter (RM926, 929)	9-0ft (2745mm)
P.D.U.	3-0ft (915mm)

STANDARD

1

1°

STEERING

2/3

1°

This specification is current at the time of publication, but may be subject to variation as a result of later improvements in design or technique. To meet the 1968 British Board of Trade marine radar specifications, a performance monitor is required.